MAXPRO200®

Instruction Manual

807700 – Revision 1

Hypertherm®

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Maintenance notes:

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MAXPRO200

Instruction Manual

807700 – Revision 1

English

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RECOGNIZE SAFETY INFORMATION

The symbols shown in this section are used to identify potential hazards. When you see a safety symbol in this manual or on your machine, understand the potential for personal injury, and follow the related instructions to avoid the hazard.

FOLLOW SAFETY INSTRUCTIONS

Read carefully all safety messages in this manual and safety labels on your machine.

- Keep the safety labels on your machine in good condition. Replace missing or damaged labels immediately.
- Learn how to operate the machine and how to use the controls properly. Do not let anyone operate it without instruction.
- Keep your machine in proper working condition. Unauthorized modifications to the machine may affect safety and machine service life.

DANGER WARNING CAUTION

Hypertherm uses American National Standards Institute guidelines for safety signal words and symbols. A signal word DANGER or WARNING is used with a safety symbol. DANGER identifies the most serious hazards.

- DANGER and WARNING safety labels are located on your machine near specific hazards.
- DANGER safety messages precede related instructions in the manual that will result in serious injury or death if not followed correctly.
- WARNING safety messages precede related instructions in this manual that may result in injury or death if not followed correctly.
- CAUTION safety messages precede related instructions in this manual that may result in minor injury or damage to equipment if not followed correctly.

ELECTRICAL HAZARDS

- Only trained and authorized personnel may open this equipment.
- If the equipment is permanently connected, turn it off, and lock out/tag out power before the enclosure is opened.
- If power is supplied to the equipment with a cord, unplug the unit before the enclosure is opened.
- Lockable disconnects or lockable plug covers must be provided by others.
- Wait 5 minutes after removal of power before entering the enclosure to allow stored energy to discharge.
- If the equipment must have power when the enclosure is open for servicing, arc flash explosion hazards may exist. Follow ALL local requirements (NFPA 70E in the USA) for safe work practices and for Personal Protective Equipment when servicing energized equipment.
- The enclosure shall be closed and the proper earth ground continuity to the enclosure verified prior to operating the equipment after moving, opening, or servicing.
- Always follow these instructions for disconnecting power before inspecting or changing torch consumable parts.

ELECTRIC SHOCK CAN KILL

Touching live electrical parts can cause a fatal shock or severe burn.

- Operating the plasma system completes an electrical circuit between the torch and the workpiece. The workpiece and anything touching the workpiece are part of the electrical circuit.
- Never touch the torch body, workpiece or the water in a water table when the plasma system is operating.

Electric shock prevention

All Hypertherm plasma systems use high voltage in the cutting process (200 to 400 VDC are common). Take the following precautions when operating this system:

- Wear insulated gloves and boots, and keep your body and clothing dry.
- Do not stand, sit or lie on – or touch – any wet surface when using the plasma system.
- Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground. If you must work in or near a damp area, use extreme caution.
- Provide a disconnect switch close to the power supply with properly sized fuses. This switch allows the operator to turn off the power supply quickly in an emergency situation.
- When using a water table, be sure that it is correctly connected to earth ground.
- Install and ground this equipment according to the instruction manual and in accordance with national and local codes.
- Inspect the input power cord frequently for damage or cracking of the cover. Replace a damaged power cord immediately. **Bare wiring can kill.**
- Inspect and replace any worn or damaged torch leads.
- Do not pick up the workpiece, including the waste cutoff, while you cut. Leave the workpiece in place or on the workbench with the work cable attached during the cutting process.
- Before checking, cleaning or changing torch parts, disconnect the main power or unplug the power supply.
- Never bypass or shortcut the safety interlocks.
- Before removing any power supply or system enclosure cover, disconnect electrical input power. Wait 5 minutes after disconnecting the main power to allow capacitors to discharge.
- Never operate the plasma system unless the power supply covers are in place. Exposed power supply connections present a severe electrical hazard.
- When making input connections, attach proper grounding conductor first.
- Each Hypertherm plasma system is designed to be used only with specific Hypertherm torches. Do not substitute other torches which could overheat and present a safety hazard.

CUTTING CAN CAUSE FIRE OR EXPLOSION

Fire prevention

- Be sure the area is safe before doing any cutting. Keep a fire extinguisher nearby.
- Remove all flammables within 35 feet (10 m) of the cutting area.
- Quench hot metal or allow it to cool before handling or before letting it touch combustible materials.
- Never cut containers with potentially flammable materials inside – they must be emptied and properly cleaned first.
- Ventilate potentially flammable atmospheres before cutting.
- When cutting with oxygen as the plasma gas, an exhaust ventilation system is required.

Explosion prevention

- Do not use the plasma system if explosive dust or vapors may be present.
- Do not cut pressurized cylinders, pipes, or any closed container.
- Do not cut containers that have held combustible materials.

WARNING
Explosion Hazard
Argon-Hydrogen and Methane

Hydrogen and methane are flammable gases that present an explosion hazard. Keep flames away from cylinders and hoses that contain methane or hydrogen mixtures. Keep flames and sparks away from the torch when using methane or argon-hydrogen plasma.

WARNING
Explosion Hazard
Underwater Cutting with Fuel Gases

- Do not cut aluminum underwater or with water touching the underside of the aluminum.
- Cutting aluminum underwater or with the water touching the underside of the aluminum can result in an explosive condition that can detonate during plasma cutting operations.

WARNING
Hydrogen Detonation with
Aluminum Cutting

- Do not cut under water with fuel gases containing hydrogen.
- Cutting under water with fuel gases containing hydrogen can result in an explosive condition that can detonate during plasma cutting operations.

TOXIC FUMES CAN CAUSE INJURY OR DEATH

The plasma arc by itself is the heat source used for cutting. Accordingly, although the plasma arc has not been identified as a source of toxic fumes, the material being cut can be a source of toxic fumes or gases that deplete oxygen.

Fumes produced vary depending on the metal that is cut. Metals that may release toxic fumes include, but are not limited to, stainless steel, carbon steel, zinc (galvanized), and copper.

In some cases, the metal may be coated with a substance that could release toxic fumes. Toxic coatings include, but are not limited to, lead (in some paints), cadmium (in some paints and fillers), and beryllium.

Gases produced by plasma cutting vary based on the material to be cut and the method of cutting, but may include ozone, oxides of nitrogen, hexavalent chromium, hydrogen, and other substances if such are contained in or released by the material being cut.

Caution should be taken to minimize exposure to fumes produced by any industrial process. Depending upon the chemical composition and concentration of the fumes (as well as other factors, such as ventilation), there may be a risk of physical illness, such as birth defects or cancer.

It is the responsibility of the equipment and site owner to test the air quality in the area where the equipment is used and to ensure that the air quality in the workplace meets all local and national standards and regulations.

The air quality level in any relevant workplace depends on site-specific variables such as:

- Table design (wet, dry, underwater).
- Material composition, surface finish, and composition of coatings.
- Volume of material removed.
- Duration of cutting or gouging.
- Size, air volume, ventilation and filtration of the work area.
- Personal protective equipment.
- Number of welding and cutting systems in operation.
- Other site processes that may produce fumes.

If the workplace must conform to national or local regulations, only monitoring or testing done at the site can determine whether the site is above or below allowable levels.

To reduce the risk of exposure to fumes:

- Remove all coatings and solvents from the metal before cutting.
- Use local exhaust ventilation to remove fumes from the air.
- Do not inhale fumes. Wear an air-supplied respirator when cutting any metal coated with, containing, or suspected to contain toxic elements.
- Assure that those using welding or cutting equipment, as well as air-supplied respiration devices, are qualified and trained in the proper use of such equipment.
- Never cut containers with potentially toxic materials inside. Empty and properly clean the container first.
- Monitor or test the air quality at the site as needed.
- Consult with a local expert to implement a site plan to ensure safe air quality.

GROUNDING SAFETY

Work cable Attach the work cable securely to the workpiece or the work table with good metal-to-metal contact. Do not connect it to the piece that will fall away when the cut is complete.

Work table Connect the work table to an earth ground, in accordance with appropriate national and local electrical codes.

Input power

- Be sure to connect the power cord ground wire to the ground in the disconnect box.
- If installation of the plasma system involves connecting the power cord to the power supply, be sure to connect the power cord ground wire properly.
- Place the power cord's ground wire on the stud first, then place any other ground wires on top of the power cord ground. Fasten the retaining nut tightly.
- Tighten all electrical connections to avoid excessive heating.

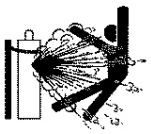
STATIC ELECTRICITY CAN DAMAGE CIRCUIT BOARDS

Use proper precautions when handling printed circuit boards:

- Store PC boards in anti-static containers.
- Wear a grounded wrist strap when handling PC boards.

COMPRESSED GAS EQUIPMENT SAFETY

- Never lubricate cylinder valves or regulators with oil or grease.
- Use only correct gas cylinders, regulators, hoses and fittings designed for the specific application.
- Maintain all compressed gas equipment and associated parts in good condition.
- Label and color-code all gas hoses to identify the type of gas in each hose. Consult applicable national and local codes.



GAS CYLINDERS CAN EXPLODE IF DAMAGED

Gas cylinders contain gas under high pressure.
If damaged, a cylinder can explode.

- Handle and use compressed gas cylinders in accordance with applicable national and local codes.
- Never use a cylinder that is not upright and secured in place.
- Keep the protective cap in place over valve except when the cylinder is in use or connected for use.
- Never allow electrical contact between the plasma arc and a cylinder.
- Never expose cylinders to excessive heat, sparks, slag or open flame.
- Never use a hammer, wrench or other tool to open a stuck cylinder valve.

A PLASMA ARC CAN CAUSE INJURY AND BURNS

Instant-on torches

Plasma arc comes on immediately when the torch switch is activated.

The plasma arc will cut quickly through gloves and skin.

- Keep away from the torch tip.
- Do not hold metal near the cutting path.
- Never point the torch toward yourself or others.

ARC RAYS CAN BURN EYES AND SKIN

Eye protection Plasma arc rays produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.

- Use eye protection in accordance with applicable national and local codes.
- Wear eye protection (safety glasses or goggles with side shields, and a welding helmet) with appropriate lens shading to protect your eyes from the arc's ultraviolet and infrared rays.

Skin protection Wear protective clothing to protect against burns caused by ultraviolet light, sparks, and hot metal.

- Gauntlet gloves, safety shoes and hat.
- Flame-retardant clothing to cover all exposed areas.
- Cuffless trousers to prevent entry of sparks and slag.
- Remove any combustibles, such as a butane lighter or matches, from your pockets before cutting.

Cutting area Prepare the cutting area to reduce reflection and transmission of ultraviolet light:

- Paint walls and other surfaces with dark colors to reduce reflection.
- Use protective screens or barriers to protect others from flash and glare.
- Warn others not to watch the arc. Use placards or signs.

Arc current (amps)	Minimum protective shade number (ANSI Z49.1:2005)	Suggested shade number for comfort (ANSI Z49.1:2005)	OSHA 29CFR 1910.133(a)(5)	Europe EN168:2002
Less than 40 A	5	5	8	9
41 to 60 A	6	6	8	9
61 to 80 A	8	8	8	9
81 to 125 A	8	9	8	9
126 to 150 A	8	9	8	10
151 to 175 A	8	9	8	11
176 to 250 A	8	9	8	12
251 to 300 A	8	9	8	13
301 to 400 A	9	12	9	13
401 to 800 A	10	14	10	N/A

PACEMAKER AND HEARING AID OPERATION

Pacemaker and hearing aid operation can be affected by magnetic fields from high currents.

Pacemaker and hearing aid wearers should consult a doctor before going near any plasma arc cutting and gouging operations.

To reduce magnetic field hazards:

- Keep both the work cable and the torch lead to one side, away from your body.
- Route the torch leads as close as possible to the work cable.
- Do not wrap or drape the torch lead or work cable around your body.
- Keep as far away from the power supply as possible.

NOISE CAN DAMAGE HEARING

Cutting with a plasma arc can exceed acceptable noise levels as defined by local codes in many applications. Prolonged exposure to excessive noise can damage hearing. Always wear proper ear protection when cutting or gouging, unless sound pressure level measurements taken at the installed site have verified personal hearing protection is not necessary per relevant international, regional, and local codes.

Significant noise reduction can be obtained by adding simple engineering controls to cutting tables such as barriers or curtains positioned between the plasma arc and the workstation; and/or locating the workstation away from the plasma arc. Implement administrative controls in the workplace to restrict access, limit operator exposure time, screen off noisy working areas and/or take measures to reduce reverberation in working areas by putting up noise absorbers.

Use ear protectors if the noise is disruptive or if there is a risk of hearing damage after all other engineering and administrative controls have been implemented. If hearing protection is required, wear only approved personal protective devices such as ear muffs or ear plugs with a noise reduction rating appropriate for the situation. Warn others in the area of possible noise hazards. In addition, ear protection can prevent hot splatter from entering the ear.

A PLASMA ARC CAN DAMAGE FROZEN PIPES

Frozen pipes may be damaged or can burst if you attempt to thaw them with a plasma torch.

DRY DUST COLLECTION INFORMATION

At some sites, dry dust can represent a potential explosion hazard.

The U.S. National Fire Protection Association's 2007 edition of NFPA standard 68, "Explosion Protection by Deflagration Venting," provides requirements for the design, location, installation, maintenance, and use of devices and systems to vent combustion gases and pressures after any deflagration event. Consult with the manufacturer or installer of any dry dust collection system for applicable requirements before you install a new dry dust collection system or make significant changes in the process or materials used with an existing dry dust collection system.

Consult your local "Authority Having Jurisdiction" (AHJ) to determine whether any edition of NFPA 68 has been "adopted by reference" in your local building codes.

Refer to NFPA68 for definitions and explanations of regulatory terms such as deflagration, AHJ, adopted by reference, the Kst value, deflagration index, and other terms.

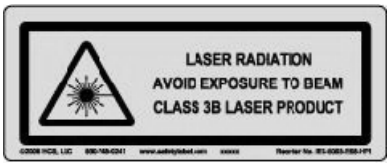
Note 1 – Hypertherm's interpretation of these new requirements is that unless a site-specific evaluation has been completed to determine that all dust generated is not combustible, the 2007 edition of NFPA 68 requires the use of explosion vents designed to the worst-case Kst value (see annex F) that could be generated from dust so that the explosion vent size and type can be designed. NFPA 68 does not specifically identify plasma cutting or other thermal cutting processes as requiring deflagration venting systems, but it does apply these new requirements to all dry dust collection systems.

Note 2 – Users of Hypertherm manuals should consult and comply with all applicable federal, state, and local laws and regulations. Hypertherm does not, by the publication of any Hypertherm manual, intend to urge action that is not in compliance with all applicable regulations and standards, and this manual may never be construed as doing so.

LASER RADIATION

Exposure to the laser output can result in serious eye injury. Avoid direct eye exposure.

For your convenience and safety, on Hypertherm products that use a laser, one of the following laser radiation labels has been applied on the product near where the laser beam exits the enclosure. The maximum output (mV), wavelength emitted (nM) and, if appropriate, the pulse duration is also provided.



Additional laser safety instructions:

- Consult with an expert on local laser regulations. Laser safety training may be required.
- Do not allow untrained persons to operate the laser. Lasers can be dangerous in the hands of untrained users.
- Do not look into the laser aperture or beam at any time.
- Position the laser as instructed to avoid unintentional eye contact.
- Do not use the laser on reflective workpieces.
- Do not use optical tools to view or reflect the laser beam.
- Do not disassemble or remove the laser or aperture cover.
- Modifying the laser or product in any way can increase the risk of laser radiation.
- Use of adjustments or performance of procedures other than those specified in this manual may result in hazardous laser radiation exposure.
- Do not operate in explosive atmospheres, such as in the presence of flammable liquids, gases, or dust.
- Use only laser parts and accessories that are recommended or provided by the manufacturer for your model.
- Repairs and servicing MUST be performed by qualified personnel.
- Do not remove or deface the laser safety label.

SYMBOLS AND MARKS

Your Hypertherm product may have one or more of the following markings on or near the data plate. Due to differences and conflicts in national regulations, not all marks are applied to every version of a product.

S mark

The S mark indicates that the power supply and torch are suitable for operations carried out in environments with increased hazard of electrical shock according to IEC 60674-1.

CSA mark

Hypertherm products with a CSA mark meet the United States and Canadian regulations for product safety. The products were evaluated, tested, and certified by CSA-International. Alternatively, the product may have a mark by one of the other Nationally Recognized Testing Laboratories (NRTL) accredited in both the United States and Canada, such as Underwriters Laboratories, Incorporated (UL) or TÜV.

CE mark

The CE marking signifies the manufacturer's declaration of conformity to applicable European directives and standards. Only those versions of Hypertherm products with a CE marking located on or near the data plate have been tested for compliance with the European Low Voltage Directive and the European Electromagnetic Compatibility (EMC) Directive. EMC filters needed to comply with the European EMC Directive are incorporated within versions of the product with a CE marking.

GOST-TR mark

CE versions of Hypertherm products that include a GOST-TR mark of conformity meet the product safety and EMC requirements for export to the Russian Federation.

c-Tick mark

CE versions of Hypertherm products with a c-Tick mark comply with the EMC regulations required for sale in Australia and New Zealand.

CCC mark

The China Compulsory Certification (CCC) mark indicates that the product has been tested and found compliant with product safety regulations required for sale in China.

UkrSEPRO mark

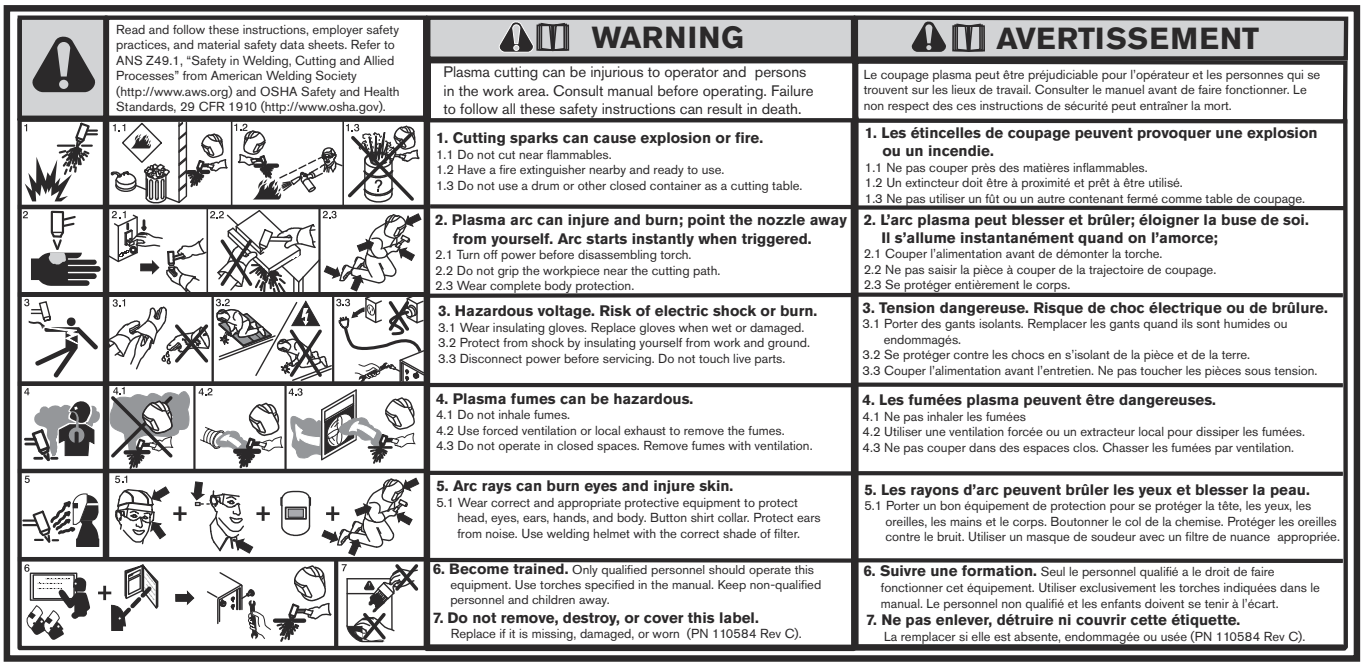
The CE versions of Hypertherm products that include a UkrSEPRO mark of conformity meet the product safety and EMC requirements for export to the Ukraine.

ADDITIONAL SAFETY INFORMATION

1. ANSI Standard Z49.1, Safety in Welding and Cutting, American Welding Society, 550 LeJeune Road P.O. Box 351020, Miami, FL 33135
2. ANSI Standard Z49.2, Fire Prevention in the Use of Cutting and Welding Processes, American National Standards Institute 1430 Broadway, New York, NY 10018
3. ANSI Standard Z87.1, Safe Practices for Occupation and Educational Eye and Face Protection, American National Standards Institute, 1430 Broadway, New York, NY 10018
4. AWS F4.1, Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances, American Welding Society 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
5. AWS F5.2, Recommended Safe Practices for Plasma Arc Cutting, American Welding Society 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
6. CGA Pamphlet P-1, Safe Handling of Compressed Gases in Cylinders, Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202
7. CSA Standard W117.2, Code for Safety in Welding and Cutting, Canadian Standards Association Standard Sales 178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3, Canada
8. NFPA Standard 51B, Cutting and Welding Processes, National Fire Protection Association 470 Atlantic Avenue, Boston, MA 02210
9. NFPA Standard 70–1978, National Electrical Code, National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210
10. OSHA, Safety and Health Standards, 29FR 1910 U.S. Government Printing Office, Washington, D.C. 20402
11. AWS Safety and Health Fact Sheets, American Welding Society 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135 www.aws.org/technical/facts/

WARNING LABELS

This warning label is affixed to some power supplies. It is important that the operator and maintenance technician understand the intent of these warning symbols as described.



Read and follow these instructions, employer safety practices, and material safety data sheets. Refer to ANS Z49.1, "Safety in Welding, Cutting and Allied Processes" from American Welding Society (http://www.aws.org) and OSHA Safety and Health Standards, 29 CFR 1910 (http://www.osha.gov).

WARNING

Plasma cutting can be injurious to operator and persons in the work area. Consult manual before operating. Failure to follow all these safety instructions can result in death.

1. Cutting sparks can cause explosion or fire.
1.1 Do not cut near flammables.
1.2 Have a fire extinguisher nearby and ready to use.
1.3 Do not use a drum or other closed container as a cutting table.

2. Plasma arc can injure and burn; point the nozzle away from yourself. Arc starts instantly when triggered.
2.1 Turn off power before disassembling torch.
2.2 Do not grip the workpiece near the cutting path.
2.3 Wear complete body protection.

3. Hazardous voltage. Risk of electric shock or burn.
3.1 Wear insulating gloves. Replace gloves when wet or damaged.
3.2 Protect from shock by insulating yourself from work and ground.
3.3 Disconnect power before servicing. Do not touch live parts.

4. Plasma fumes can be hazardous.
4.1 Do not inhale fumes.
4.2 Use forced ventilation or local exhaust to remove the fumes.
4.3 Do not operate in closed spaces. Remove fumes with ventilation.

5. Arc rays can burn eyes and injure skin.
5.1 Wear correct and appropriate protective equipment to protect head, eyes, ears, hands, and body. Button shirt collar. Protect ears from noise. Use welding helmet with the correct shade of filter.

6. Become trained. Only qualified personnel should operate this equipment. Use torches specified in the manual. Keep non-qualified personnel and children away.

7. Do not remove, destroy, or cover this label.
Replace if it is missing, damaged, or worn (PN 110584 Rev C).

AVERTISSEMENT

Le coupage plasma peut être préjudiciable pour l'opérateur et les personnes qui se trouvent sur les lieux de travail. Consulter le manuel avant de faire fonctionner. Le non respect des ces instructions de sécurité peut entraîner la mort.

1. Les étincelles de coupage peuvent provoquer une explosion ou un incendie.
1.1 Ne pas couper près des matières inflammables.
1.2 Un extincteur doit être à proximité et prêt à être utilisé.
1.3 Ne pas utiliser un fût ou un autre contenant fermé comme table de coupage.

2. L'arc plasma peut blesser et brûler; éloigner la buse de soi. Il s'allume instantanément quand on l'amorce;
2.1 Couper l'alimentation avant de démonter la torche.
2.2 Ne pas saisir la pièce à couper de la trajectoire de coupage.
2.3 Se protéger entièrement le corps.

3. Tension dangereuse. Risque de choc électrique ou de brûlure.
3.1 Porter des gants isolants. Remplacer les gants quand ils sont humides ou endommagés.
3.2 Se protéger contre les chocs en s'isolant de la pièce et de la terre.
3.3 Couper l'alimentation avant l'entretien. Ne pas toucher les pièces sous tension.

4. Les fumées plasma peuvent être dangereuses.
4.1 Ne pas inhaler les fumées
4.2 Utiliser une ventilation forcée ou un extracteur local pour dissiper les fumées.
4.3 Ne pas couper dans des espaces clos. Chasser les fumées par ventilation.

5. Les rayons d'arc peuvent brûler les yeux et blesser la peau.
5.1 Porter un bon équipement de protection pour se protéger la tête, les yeux, les oreilles, les mains et le corps. Boutonner le col de la chemise. Protéger les oreilles contre le bruit. Utiliser un masque de soudeur avec un filtre de nuance appropriée.

6. Suivre une formation. Seul le personnel qualifié a le droit de faire fonctionner cet équipement. Utiliser exclusivement les torches indiquées dans le manual. Le personnel non qualifié et les enfants doivent se tenir à l'écart.

7. Ne pas enlever, détruire ni couvrir cette étiquette.
La remplacer si elle est absente, endommagée ou usée (PN 110584 Rev C).

WARNING LABELS

This warning label is affixed to some power supplies. It is important that the operator and maintenance technician understand the intent of these warning symbols as described. The numbered text corresponds to the numbered boxes on the label.

1. Cutting sparks can cause explosion or fire.

1.1 Do not cut near flammables.

1.2 Have a fire extinguisher nearby and ready to use.

1.3 Do not use a drum or other closed container as a cutting table.

2. Plasma arc can injure and burn; point the nozzle away from yourself. Arc starts instantly when triggered.

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2.2 Do not grip the workpiece near the cutting path.

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6. Become trained. Only qualified personnel should operate this equipment. Use torches specified in the manual. Keep non-qualified personnel and children away.

7. Do not remove, destroy, or cover this label. Replace if it is missing, damaged, or worn.

Introduction

Hypertherm's CE-marked equipment is built in compliance with standard EN60974-10. The equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

The limits required by EN60974-10 may not be adequate to completely eliminate interference when the affected equipment is in close proximity or has a high degree of sensitivity. In such cases it may be necessary to use other measures to further reduce interference.

This cutting equipment is designed for use only in an industrial environment.

Installation and use

The user is responsible for installing and using the plasma equipment according to the manufacturer's instructions.

If electromagnetic disturbances are detected then it shall be the responsibility of the user to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing the cutting circuit, see *Earthing of the work piece*. In other cases, it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases, electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Assessment of area

Before installing the equipment, the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

a. Other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the cutting equipment.

b. Radio and television transmitters and receivers.

c. Computer and other control equip.

d. Safety critical equipment, for example guarding of industrial equipment.

e. Health of the people around, for example the use of pacemakers and hearing aids.

f. Equipment used for calibration or measurement.

g. Immunity of other equipment in the environment. User shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures.

h. Time of day that cutting or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

Methods of reducing emissions

Mains supply

Cutting equipment must be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply.

Consideration should be given to shielding the supply cable of permanently installed cutting equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the cutting mains supply so that good electrical contact is maintained between the conduit and the cutting power source enclosure.

Maintenance of cutting equipment

The cutting equipment must be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the cutting equipment is in operation. The cutting equipment should not be modified in any way, except as set forth in and in accordance with the manufacturer's written instructions. For example, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Cutting cables

The cutting cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

Equipotential bonding

Bonding of all metallic components in the cutting installation and adjacent to it should be considered.

However, metallic components bonded to the workpiece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode (nozzle for laser heads) at the same time.

The operator should be insulated from all such bonded metallic components.

Earthing of the workpiece

Where the workpiece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, for example, ship's hull or building steel work, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitances selected according to national regulations.

Note: The cutting circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will in crease the risk of injury, for example, by allowing parallel cutting current return paths which may damage the earth circuits of other equipment. Further guidance is provided in IEC 60974-9, Arc Welding Equipment, Part 9: Installation and Use.

Screening and shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire plasma cutting installation may be considered for special applications.

Attention

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage or injury caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty, and will constitute misuse of the Hypertherm Product.

You are solely responsible for the safe use of the Product. Hypertherm does not and cannot make any guarantee or warranty regarding the safe use of the product in your environment.

General

Hypertherm, Inc. warrants that its Products shall be free from defects in materials and workmanship for the specific periods of time set forth herein and as follows: if Hypertherm is notified of a defect (i) with respect to the plasma power supply within a period of two (2) years from the date of its delivery to you, with the exception of Powermax brand power supplies, which shall be within a period of three (3) years from the date of delivery to you, and (ii) with respect to the torch and leads within a period of one (1) year from its date of delivery to you, and with respect to torch lifter assemblies within a period of one (1) year from its date of delivery to you, and with respect to Automation products one (1) year from its date of delivery to you, with the exception of the EDGE Pro CNC and ArcGlide THC, which shall be within a period of two (2) years from the date of delivery to you, and (iii) with respect to HyIntensity fiber laser components within a period of two (2) years from the date of its delivery to you, with the exception of laser heads and beam delivery cables, which shall be within a period of one (1) year from its date of delivery to you.

This warranty shall not apply to any Powermax brand power supplies that have been used with phase converters. In addition, Hypertherm does not warranty systems that have been damaged as a result of poor power quality, whether from phase converters or incoming line power. This warranty shall not apply to any product which has been incorrectly installed, modified, or otherwise damaged.

Hypertherm provides repair, replacement or adjustment of the Product as the sole and exclusive remedy, if and only if the warranty set forth herein properly is invoked and applies. Hypertherm, at its sole option, shall repair, replace, or adjust, free of charge, any defective Products covered by this warranty which shall be returned with Hypertherm's prior authorization (which shall not be unreasonably withheld), properly packed, to Hypertherm's place of business in Hanover, New Hampshire, or to an authorized Hypertherm repair facility, all costs, insurance and freight pre paid by the customer. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph and with Hypertherm's prior written consent.

The warranty set forth above is exclusive and is in lieu of all other warranties, express, implied, statutory, or otherwise with respect to the Products or as to the results which may be obtained therefrom, and all implied warranties or conditions of quality or of merchantability or fitness for a particular purpose or against infringement. The foregoing shall constitute the sole and exclusive remedy for any breach by Hypertherm of its warranty.

Distributors/OEMs may offer different or additional warranties, but Distributors/OEMs are not authorized to give any additional warranty protection to you or make any representation to you purporting to be binding upon Hypertherm.

Patent indemnity

Except only in cases of products not manufactured by Hypertherm or manufactured by a person other than Hypertherm not in strict conformity with Hypertherm's specifications and in cases of designs, processes, formulae, or combinations not developed or purported to be developed by Hypertherm, Hypertherm will have the right to defend or settle, at its own expense, any suit or proceeding brought against you alleging that the use of the Hypertherm product, alone and not in combination with any other product not supplied by Hypertherm, infringes any patent of any third party. You shall notify Hypertherm promptly upon learning of any action or threatened action in connection with any such alleged infringement (and in any event no longer than fourteen (14) days after learning of any action or threat of action), and Hypertherm's obligation to defend shall be conditioned upon Hypertherm's sole control of, and the indemnified party's cooperation and assistance in, the defense of the claim.

Limitation of liability

In no event shall Hypertherm be liable to any person or entity for any incidental, consequential direct, indirect, punitive or exemplary damages (including but not limited to lost profits) regardless of whether such liability is based on breach of contract, tort, strict liability, breach of warranty, failure of essential purpose, or otherwise, and even if advised of the possibility of such damages.

National and local codes

National and local codes governing plumbing and electrical installation shall take precedence over any instructions contained in this manual. In no event shall Hypertherm be liable for injury to persons or property damage by reason of any code violation or poor work practices.

Liability cap

In no event shall Hypertherm's liability, if any, whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise, for any claim, action, suit or proceeding (whether in court, arbitration, regulatory proceeding or otherwise) arising out of or relating to the use of the Products exceed in the aggregate the amount paid for the Products that gave rise to such claim.

Insurance

At all times you will have and maintain insurance in such quantities and types, and with coverage sufficient and appropriate to defend and to hold Hypertherm harmless in the event of any cause of action arising from the use of the products.

Transfer of rights

You may transfer any remaining rights you may have hereunder only in connection with the sale of all or substantially all of your assets or capital stock to a successor in interest who agrees to be bound by all of the terms and conditions of this Warranty. Within thirty (30) days before any such transfer occurs, you agree to notify in writing Hypertherm, which reserves the right of approval. Should you fail timely to notify Hypertherm and seek its approval as set forth herein, the Warranty set forth herein shall be null and void and you will have no further recourse against Hypertherm under the Warranty or otherwise.

Introduction

Hypertherm maintains a global Regulatory Management System to ensure that products comply with regulatory and environmental requirements.

National and local safety regulations

National and Local safety regulations shall take precedence over any instructions provided with the product. The product shall be imported, installed, operated and disposed of in accordance with national and local regulations applicable to the installed site.

Certification test marks

Certified products are identified by one or more certification test marks from accredited testing laboratories. The certification test marks are located on or near the data plate.

Each certification test mark means that the product and its safety-critical components conform to the relevant national safety standards as reviewed and determined by that testing laboratory. Hypertherm places a certification test mark on its products only after that product is manufactured with safety-critical components that have been authorized by the accredited testing laboratory.

Once the product has left the Hypertherm factory, the certification test marks are invalidated if any of the following occurs:

- The product is modified in a manner that creates a hazard or non-conformance with the applicable standards.
- Safety-critical components are replaced with unauthorized spare parts.
- Any unauthorized assembly, or accessory that uses or generates a hazardous voltage is added.
- There is any tampering with a safety circuit or other feature that is designed into the product as part of the certification, or otherwise.

CE marking constitutes a manufacturer's declaration of conformity to applicable European directives and standards. Only those versions of Hypertherm products with a CE Marking located on or near the data plate have been tested for compliance with the European Low Voltage Directive and the European EMC Directive. EMC filters needed to comply with the European EMC Directive are incorporated within versions of the power supply with a CE Marking.

Certificates of compliance for Hypertherm products are available from the Downloads Library on the Hypertherm web site at https://www.hypertherm.com.

Differences in national standards

Nations may apply different performance, safety or other standards. National differences in standards include, but are not limited to:

- Voltages
- Plug and cord ratings
- Language requirements
- Electromagnetic compatibility requirements

These differences in national or other standards may make it impossible or impractical for all certification test marks to be placed on the same version of a product. For example, the CSA versions of Hypertherm's products do not comply with European EMC requirements, and therefore do not have a CE marking on the data plate.

Countries that require CE marking or have compulsory EMC regulations must use CE versions of Hypertherm products with the CE marking on the data plate. These include, but are not limited to:

- Australia
- New Zealand
- Countries in the European Union
- Russia

It is important that the product and its certification test mark be suitable for the end-use installation site. When Hypertherm products are shipped to one country for export to another country; the product must be configured and certified properly for the end-use site.

Safe installation and use of shape cutting equipment

IEC 60974-9, titled Arc Welding Equipment – Installation and use, provides guidance in the safe installation and use of shape cutting equipment and the safe performance of cutting operations. The requirements of national and local regulations shall be taken into consideration during installation, including, but not limited to, grounding or protective earth connections, fuses, supply disconnecting device, and type of supply circuit. Read these instructions before installing the equipment. The first and most important step is the safety assessment of the installation.

The safety assessment must be performed by an expert, and determines what steps are necessary to create a safe environment, and what precautions should be adopted during the actual installation and operation.

Procedures for periodic inspection and testing

Where required by local national regulations, IEC 60974-4 specifies test procedures for periodic inspection and after repair or maintenance, to ensure electrical safety for plasma cutting power sources built in conformity with IEC 60974-1. Hypertherm performs the continuity of the protective circuit and insulation resistance tests in the factory as non-operating tests. The tests are performed with the power and ground connections removed.

Hypertherm also removes some protective devices that would cause false test results. Where required by local national regulations, a label shall be attached to the equipment to indicate that it has passed the tests prescribed by IEC60974-4. The repair report shall indicate the results of all tests unless an indication is made that a particular test has not been performed.

Qualification of test personnel

Electrical safety tests for shape cutting equipment can be hazardous and shall be carried out by an expert in the field of electrical repair, preferably someone also familiar with welding, cutting, and allied processes. The safety risks to personnel and equipment, when unqualified personnel are performing these tests, may be much greater than the benefit of periodic inspection and testing.

Hypertherm recommends that only visual inspection be performed unless the electrical safety tests are specifically required by local national regulations in the country where the equipment is installed.

Residual current devices (RCDs)

In Australia and some other countries, local codes may require the use of a Residual Current Devices (RCD) when portable electrical equipment is used in the workplace or at construction sites to protect operators from electrical faults in the equipment. RCDs are designed to safely disconnect the mains electrical supply when an imbalance is detected between the supply and return current (there is a leakage current to earth). RCDs are available with both fixed and adjustable trip currents between 6 to 40 milliamperes and a range of trip times up to 300 milliseconds selected for the equipment installation, application and intended use. Where RCDs are used, the trip current and trip time on RCDs should be selected or adjusted high enough to avoid nuisance tripping during normal operation of the plasma cutting equipment and low enough in the extremely unlikely event of an electrical fault in the equipment to disconnect the supply before the leakage current under a fault condition can pose a life threatening electrical hazard to operators.

To verify that the RCDs continue to function properly over time, both the trip current and the trip time should be tested periodically. Portable electrical equipment and RCDs used in commercial and industrial areas in Australia and New Zealand are tested to the Australian standard AS/NZS 3760. When you test the insulation of plasma cutting equipment to AS/NZS 3760, measure the insulation resistance according to Appendix B of the standard, at 250 VDC with the power switch in the ON position to verify proper testing and to avoid the false failure of the leakage current test. False failures are possible because the metal oxide varistors (MOVs) and electromagnetic compatibility (EMC) filters, used to reduce emissions and protect the equipment from power surges, may conduct up to 10 milliamperes leakage current to earth under normal conditions.

If you have any questions regarding the application or interpretation of any IEC standards described here, you are required to consult with an appropriate legal or other advisor familiar with the International Electrotechnical standards, and shall not rely on Hypertherm in any respect regarding the interpretation or application of such standards.

Higher-level systems

When a system integrator adds additional equipment; such as cutting tables, motor drives, motion controllers or robots; to a Hypertherm plasma cutting system, the combined system may be considered a higher-level system. A higher-level system with hazardous moving parts may constitute industrial machinery or robotic equipment, in which case the OEM or end-use customer may be subject to additional regulations and standards than those relevant to the plasma cutting system as manufactured by Hypertherm.

It is the responsibility of the end-use customer and the OEM to perform a risk assessment for the higher-level system, and to provide protection against hazardous moving parts. Unless the higher-level system is certified when the OEM incorporates Hypertherm products into it, the installation also may be subject to approval by local authorities. Seek advice from legal counsel and local regulatory experts if you are uncertain about compliance.

External interconnecting cables between component parts of the higher level system must be suitable for contaminants and movement as required by the final end use installation site. When the external interconnecting cables are subject to oil, dust, water, or other contaminants, hard usage ratings may be required.

When external interconnecting cables are subject to continuous movement, constant flexing ratings may be required. It is the responsibility of the end-use customer or the OEM to ensure the cables are suitable for the application. Since there are differences in the ratings and costs that can be required by local regulations for higher level systems, it is necessary to verify that any external interconnecting cables are suitable for the end-use installation site.

Introduction

The Hypertherm Environmental Specification requires RoHS, WEEE and REACH substance information to be provided by Hypertherm's suppliers.

Product environmental compliance does not address the indoor air quality or environmental release of fumes by the end user. Any materials that are cut by the end user are not provided by Hypertherm with the product. The end user is responsible for the materials being cut as well as for safety and air quality in the workplace. The end user must be aware of the potential health risks of the fumes released from the materials being cut and comply with all local regulations.

National and local environmental regulations

National and local environmental regulations shall take precedence over any instructions contained in this manual.

The product shall be imported, installed, operated and disposed of in accordance with all national and local environmental regulations applicable to the installed site.

The European Environmental regulations are discussed later in *The WEEE Directive*.

The RoHS directive

Hypertherm is committed to complying with all applicable laws and regulations, including the European Union Restriction of Hazardous Substances (RoHS) Directive that restricts the use of hazardous materials in electronics products. Hypertherm exceeds RoHS Directive compliance obligations on a global basis.

Hypertherm continues to work toward the reduction of RoHS materials in our products, which are subject to the RoHS Directive, except where it is widely recognized that there is no feasible alternative.

Declarations of RoHS Conformity have been prepared for the current CE versions of Powermax plasma cutting systems manufactured by Hypertherm. There is also a "RoHS mark" on the Powermax CE versions below the "CE Marking" on the data plate of CE versions of Powermax series units shipped since 2006. Parts used in CSA versions of Powermax and other products manufactured by Hypertherm that are either out of scope or exempt from RoHS are continuously being converted to RoHS compliance in anticipation of future requirements.

Proper disposal of Hypertherm products

Hypertherm plasma cutting systems, like all electronic products, may contain materials or components, such as printed circuit boards, that cannot be discarded with ordinary waste. It is your responsibility to dispose of any Hypertherm product or component part in an environmentally acceptable manner according to national and local codes.

- In the United States, check all federal, state, and local laws.
- In the European Union, check the EU directives, national, and local laws. For more information, visit www.hypertherm.com/weee.
- In other countries, check national and local laws.
- Consult with legal or other compliance experts when appropriate.

The WEEE directive

On January 27, 2003, the European Parliament and the Council of the European Union authorized Directive 2002/96/EC or WEEE (Waste Electrical and Electronic Equipment).

As required by the legislation, any Hypertherm product covered by the directive and sold in the EU after August 13, 2005 is marked with the WEEE symbol. This directive encourages and sets specific criteria for the collection, handling, and recycling of EEE waste. Consumer and business-to-business wastes are treated differently (all Hypertherm products are considered business-to-business). Disposal instructions for the CE versions of Powermax plasma systems can be found at www.hypertherm.com/weee.

The URL is printed on the symbol-only warning label for each of these CE version Powermax series units shipped since 2006. The CSA versions of Powermax and other products manufactured by Hypertherm are either out of scope or exempt from WEEE.

The REACH regulation

The REACH regulation (1907/2006), in force since June 1, 2007, has an impact on chemicals available to the European market. The REACH regulation requirements for component manufacturers states that the component shall not contain more than 0.1% by weight of the Substances of Very High Concern (SVHC).

Component manufacturers and other downstream users, such as Hypertherm, are obligated to obtain assurances from its suppliers that all chemicals used in or on Hypertherm products will have a European Chemical Agency (ECHA) registration number. To provide chemical information as required by the REACH regulation, Hypertherm requires suppliers to provide REACH declarations and identify any known use of REACH SVHC. Any use of SVHC in amounts exceeding 0.1% w/w of the parts has been eliminated. The MSDS contains a full disclosure of all substances in the chemical and can be used to verify REACH SVHC compliance.

The lubricants, sealants, coolants, adhesives, solvents, coatings and other preparations or mixtures used by Hypertherm in, on, for, or with its shape cutting equipment are used in very small quantities (except the coolant) and are commercially available with multiple sources that can and will be replaced in the event of a supplier problem associated with REACH Registration or REACH Authorization (SVHCs).

Proper handling and safe use of chemicals

Chemical Regulations in the USA, Europe, and other locations require that Material Safety Data Sheets (MSDS) be made available for all chemicals. The list of chemicals is provided by Hypertherm. The MSDS are for chemicals provided with the product and other chemicals used in or on the product. MSDS can be downloaded from the Downloads Library on the Hypertherm web site at https://www.hypertherm.com. On the Search screen, insert MSDS in the document title and click on Search.

In the USA, OSHA does not require Material Safety Data Sheets for articles such as electrodes, swirl rings, retaining caps, nozzles, shields, deflectors and other solid parts of the torch.

Hypertherm does not manufacture or provide the materials that are cut and has no knowledge whether the fumes released from materials that are cut will pose a physical hazard or health risk. Please consult with your supplier or other technical advisor if you need guidance concerning the properties of the material you will cut using a Hypertherm product.

Fumes emission and air quality

Note: The following information on air quality is intended for general information only and should not be used as a substitute for reviewing and implementing applicable government regulations or legal standards in the country where the cutting equipment will be installed and operated.

In the USA, the National Institute for Occupational Safety and Health (NIOSH) Manual of Analytical Methods (NMAM) is a collection of methods for sampling and analyzing contaminants in workplace air. Methods published by others, such as OSHA, MSHA, EPA, ASTM, ISO or commercial suppliers of sampling and analytical equipment, may have advantages over NIOSH methods.

For example, ASTM Practice D 4185 is a standard practice for the collection, dissolution, and determination of trace metals in workplace atmospheres. The sensitivity, detection limit, and optimum working concentrations for 23 metals are listed in ASTM D 4185. An industrial hygienist should be used to determine the optimum sampling protocol, considering analytical accuracy, cost, and optimum sample number. Hypertherm uses a third party industrial hygienist to perform and interpret air quality testing results taken by air sampling equipment positioned at operator stations in Hypertherm buildings where plasma cutting tables are installed and operated.

Where applicable, Hypertherm also uses a third party industrial hygienist to obtain air and water permits.

If you are not fully aware and up to date on all applicable government regulations and legal standards for the installation site, you should consult a local expert prior to purchasing, installing, and operating the equipment.

System description

General

The MAXPRO200 plasma system is designed to cut a wide range of thicknesses of mild steel, stainless steel, and aluminum.

Power supply

The power supply is a 200 A, 165 VDC constant-current supply. It contains the circuitry to ignite a torch, plus a heat exchanger and a pump to cool the chopper and torch. The power supply has a discrete machine interface to provide communication with a CNC.

Ignition console

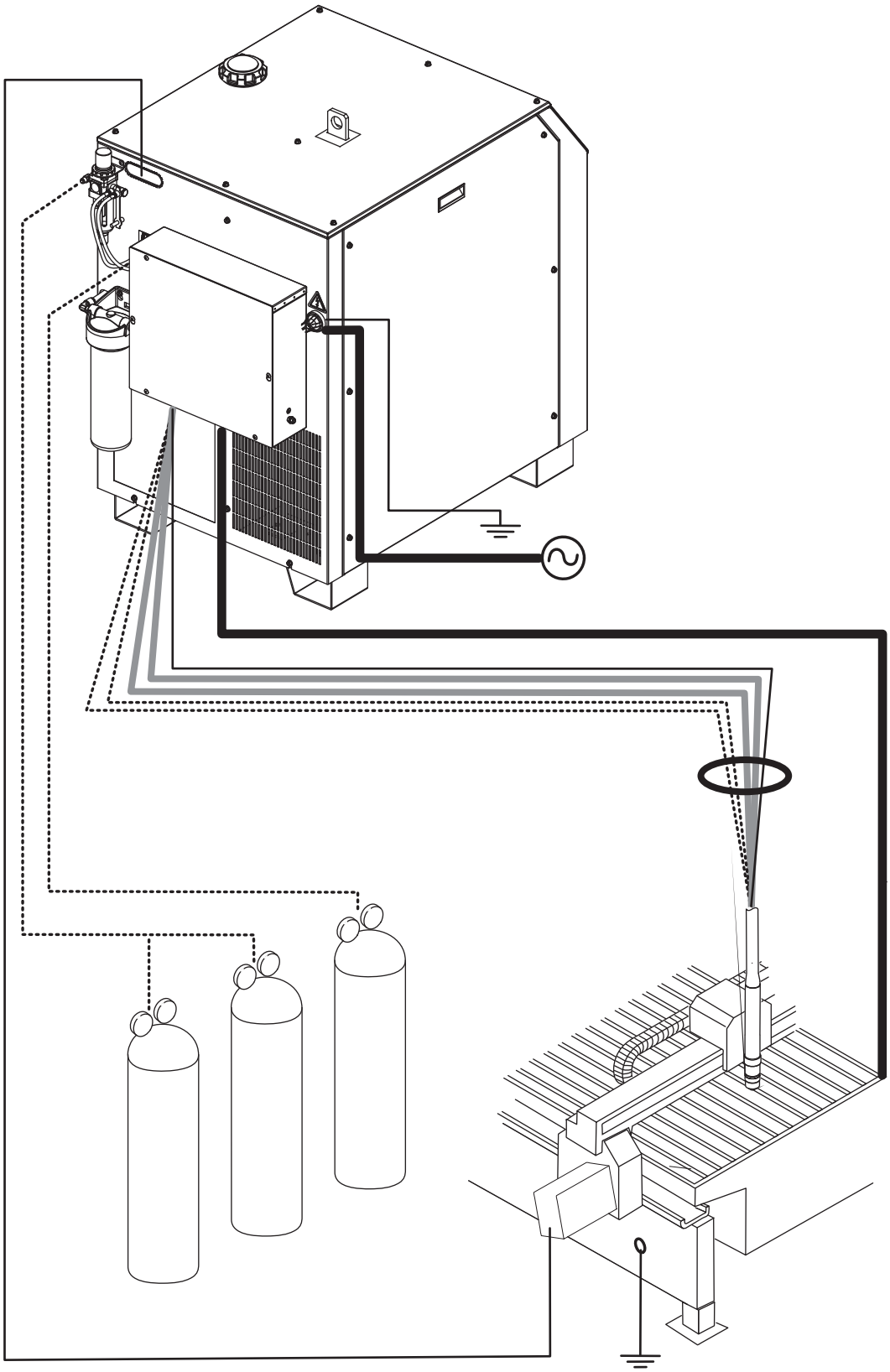
The ignition console is attached to the outside of the rear panel of the power supply enclosure. The ignition console uses a spark-gap assembly. The ignition console converts 120 VAC control voltage from the power supply into high-frequency and high-voltage pulses (9–10 kV) to initiate the pilot arc at the torch electrode-nozzle gap. The high-voltage, high-frequency signal is coupled to the pilot arc lead.

Torch

- The maximum production cutting capacity is the maximum thickness that can be cut with a 100% duty cycle. The maximum production cutting capacity of the MAXPRO200 torch is 32 mm (1-1/4 inches) for mild steel using the 200 amp O_2/Air process, 22 mm (7/8 inch) for stainless steel, and 19 mm (5/8 inch) for aluminum using the 200 amp Air/Air process.
- Maximum pierce capacity is 32 mm (1.25 inches) for mild steel, 25 mm (1 inch) for stainless steel, and 32 mm (1.25 inch) for aluminum.
- The maximum severance capacity is the maximum thickness that can be severed without regard for speed and cut quality. This thickness should only be cut occasionally and cannot be cut with a 100% duty cycle. The maximum severance capacity of the MAXPRO200 torch is 75 mm (3 inches) for mild steel, 63 mm (2-1/2 inches) for stainless steel, and 75 mm (3 inches) for aluminum.

Gas system

The gas system manages the pressure and timing of the gas supplied to the torch. It consists of a regulator, proportional valves, pressure transducers, and an inline valve located in the torch lead.

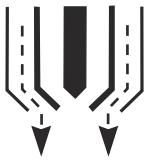
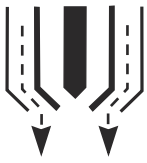
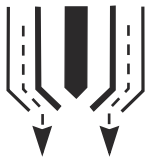


Cooling system

The cooling system uses a liquid-to-air cooled heat exchanger and a pump to reduce the temperature of the coolant. The coolant cools the chopper, torch lead and torch. The cooling system also contains flow and temperature sensors that verify the cooling system is working properly.

System gas requirements

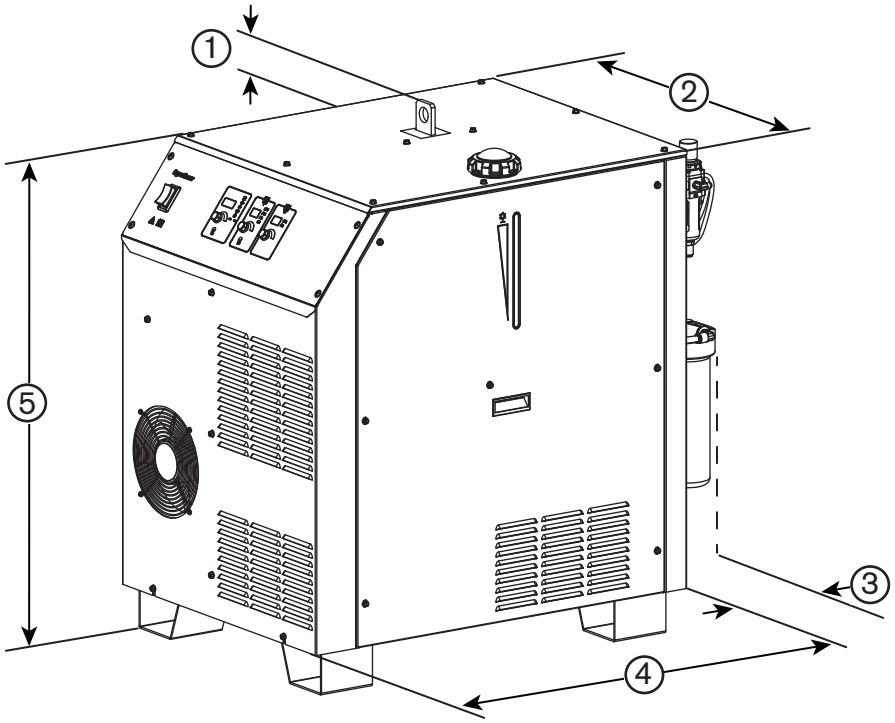
Gas quality and pressure requirements			
Gases	**Quality**	**Pressure +/- 10%**	**Flow rate**
O_2 oxygen	99.5% pure (liquid gas recommended) Clean, dry, and oil free	621 kPa / 6.2 bar / 90 psi	3400 l/h 120 scfh
N_2 nitrogen	99.9% pure (liquid gas recommended) Clean, dry, and oil free	621 kPa / 6.2 bar / 90 psi	11330 l/h 400 scfh
Air	Clean, dry, and oil free (ISO 8573-1 class 1.4.2)	621 kPa / 6.2 bar / 90 psi	11330 l/h 400 scfh

Gases by process						
	Mild steel		**Stainless steel**		**Aluminum**	
Amperage	Plasma gas	Shield gas 	Plasma gas	Shield gas 	Plasma gas	Shield gas 
Cutting 50 A	Air or O_2	Air	Air	Air	Air	Air
Cutting 130 A	Air or O_2	Air	Air	Air	Air	Air
Cutting 130 A			N_2	N_2	N_2	N_2
Cutting 200 A	Air or O_2	Air	Air	Air	Air	Air
Cutting 200 A			N_2	N_2	N_2	N_2

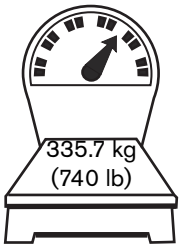
Power supply

Maximum Open Circuit Voltage (OCV) (U_0)	360 VDC
Maximum output current (I_2)	200 Amps
Output voltage (U_2)	50 – 165 VDC
Duty cycle rating (X)	100% @ 33 kW, 40° C (104° F)
Ambient temperature/Duty cycle	Power supplies will operate between (-10°C – 40°C) -10° C and +40° C (+14° and 104° F)
Power factor (cosφ)	0.98 @ 33 kW output
Cooling	Forced air (Class F)
Insulation	Class H

Power supply part numbers	AC Voltage (U_1)	Phase	Frequency (Hz)	Amperage I_1	Regulatory approval	Power kVA (+/- 10%) (U_1 x I_1 x 1.73)
078610	200/208	3	50	108/104	CSA	37.4
078611	220	3	50-60	98	CSA	37.4
078612	240	3	60	90	CSA	37.4
078613	380	3	50	57	CCC	37.4
078614	400	3	50-60	54	CE/GOST-R	37.4
078615	415	3	50	52	CE/GOST-R	37.4
078616	440	3	50-60	49	CSA	37.4
078609	480	3	60	45	CSA	37.4
078617	600	3	60	36	CSA	37.4



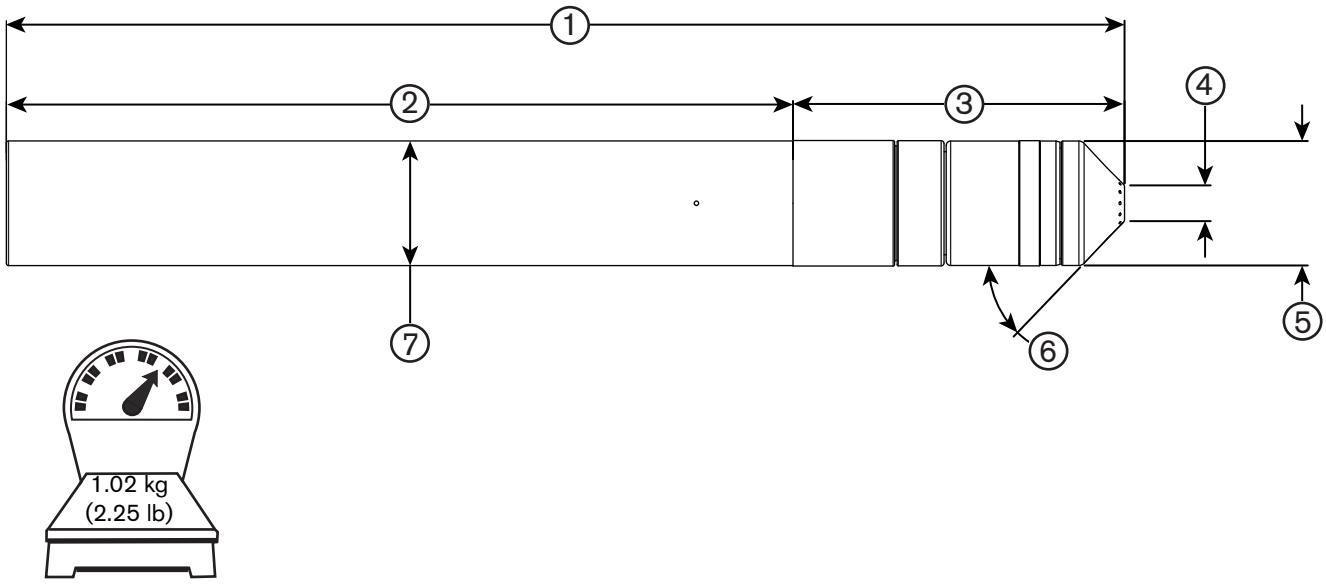
1	63.5 mm (2.5 inches)
2	688 mm (27.1 inches)
3	133 mm (5.25 inches)
4	998 mm (39.3 inches)
5	927 mm (40.1 inches)



Mechanized torches

Straight torch – 428024

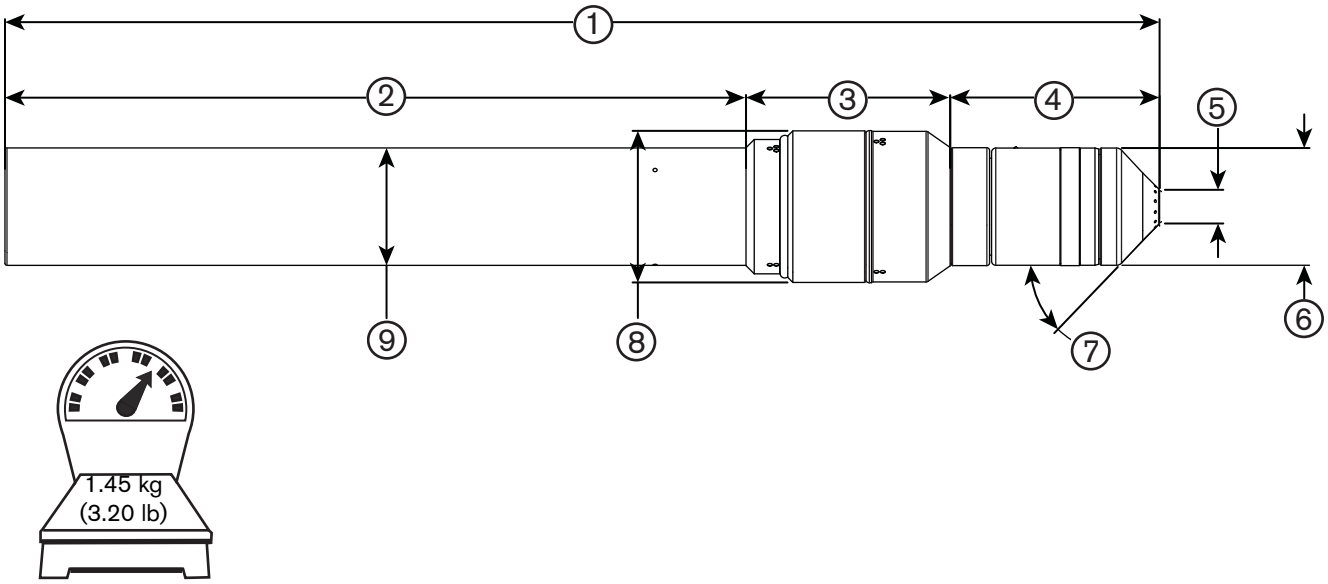
- The outside diameter of the torch mounting sleeve is 50.8 mm (2.0 inches)
- The minimum bend radius for the torch lead is 152.4 mm (6.0 inches)



1	397.15 mm (15.64 inches)
2	279.40 mm (11.00 inches)
3	117.75 mm (4.64 inches)
4	12.70 mm (0.50 inches)
5	44.20 mm (1.74 inches)
6	46 degrees
7	44.20 mm (1.74 inches)

Quick-disconnect torch – 428027 or 428028

- The torch mounting sleeve for the quick-disconnect torch is available with an outside diameter of 50.8 mm (2.0 inches) or 44.45 mm (1.75 inches)
- The minimum bend radius for the torch lead is 152.4 mm (6.0 inches)

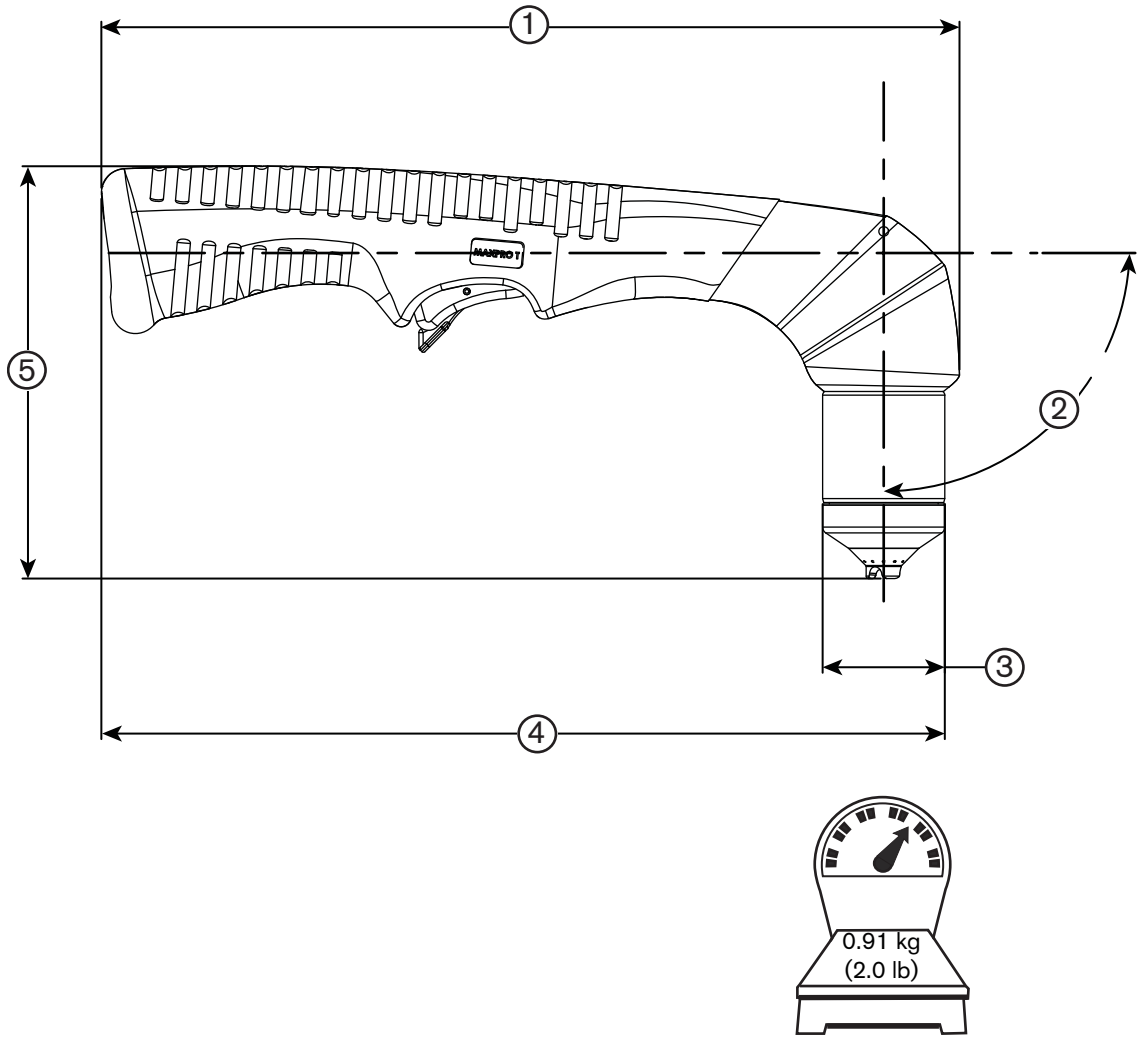


1	435.33 mm (17.14 inches)
2	279.40 mm (11.00 inches)
3	76.98 mm (3.03 inches)
4	78.95 mm (3.11 inches)
5	12.70 mm (0.50 inches)
6	44.20 mm (1.74 inches)
7	46 degrees
8	57.15 mm (2.25 inches)
9	44.20 mm (1.74 inches)

Hand torches

90 degree hand torch – 420108

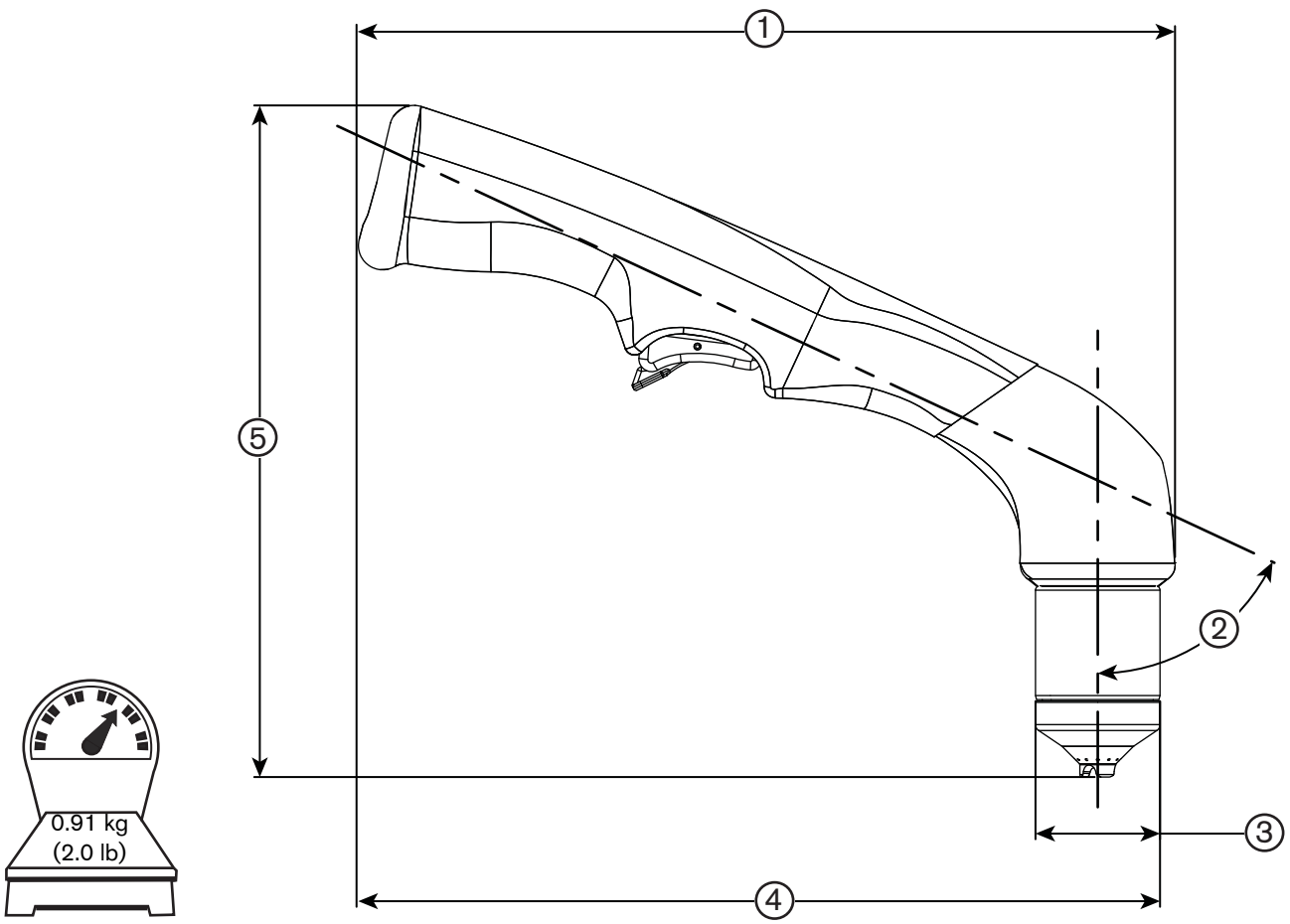
- The minimum bend radius for the torch lead is 152.4 mm (6.0 inches)



1	310.40 mm (12.22 inches)
2	90 degrees
3	44.20 mm (1.74 inches)
4	305.05 mm (12.01 inches)
5	149.10 mm (5.87 inches)

65 degree hand torch – 420107

- The minimum bend radius for the torch lead is 152.4 mm (6.0 inches)



1	290.58 mm (11.44 inches)
2	65 degrees
3	44.20 mm (1.74 inches)
4	285.24 mm (11.23 inches)
5	238.51 mm (9.39 inches)

Upon receipt

- Verify that all system components on your order have been received. Contact your supplier if any items are missing.
- Inspect the system components for any physical damage that may have occurred during shipping. If there is evidence of damage, refer to *Claims*. All communications regarding claims must include the model number and serial number located on the rear of the power supply.

Claims

Claims for damage during shipment – If your unit was damaged during shipment, you must file a claim with the carrier. Hypertherm will furnish you with a copy of the bill of lading upon request. If you need additional assistance, call customer service listed in the front of this manual, or your authorized Hypertherm distributor.

Claims for defective or missing merchandise – If any of the merchandise is defective or missing, contact your supplier. If you need additional assistance, call Customer Service listed in the front of this manual, or your authorized Hypertherm distributor.

Installation requirements

All installation and service of the electrical and plumbing systems must conform to national and local electrical and plumbing codes. This work should be performed only by qualified, licensed personnel.

Direct any technical questions to the nearest Hypertherm Technical Service Department listed in the front of this manual, or your authorized Hypertherm distributor.

Noise levels

Acceptable noise levels as defined by national and local codes may be exceeded by this plasma system. Always wear proper ear protection when cutting or gouging. Any noise measurements taken are dependant on the specific environment in which the system is used. See also *Noise can damage hearing* in the Safety section of this manual. Specific information by product can be found in the Hypertherm downloads library at:

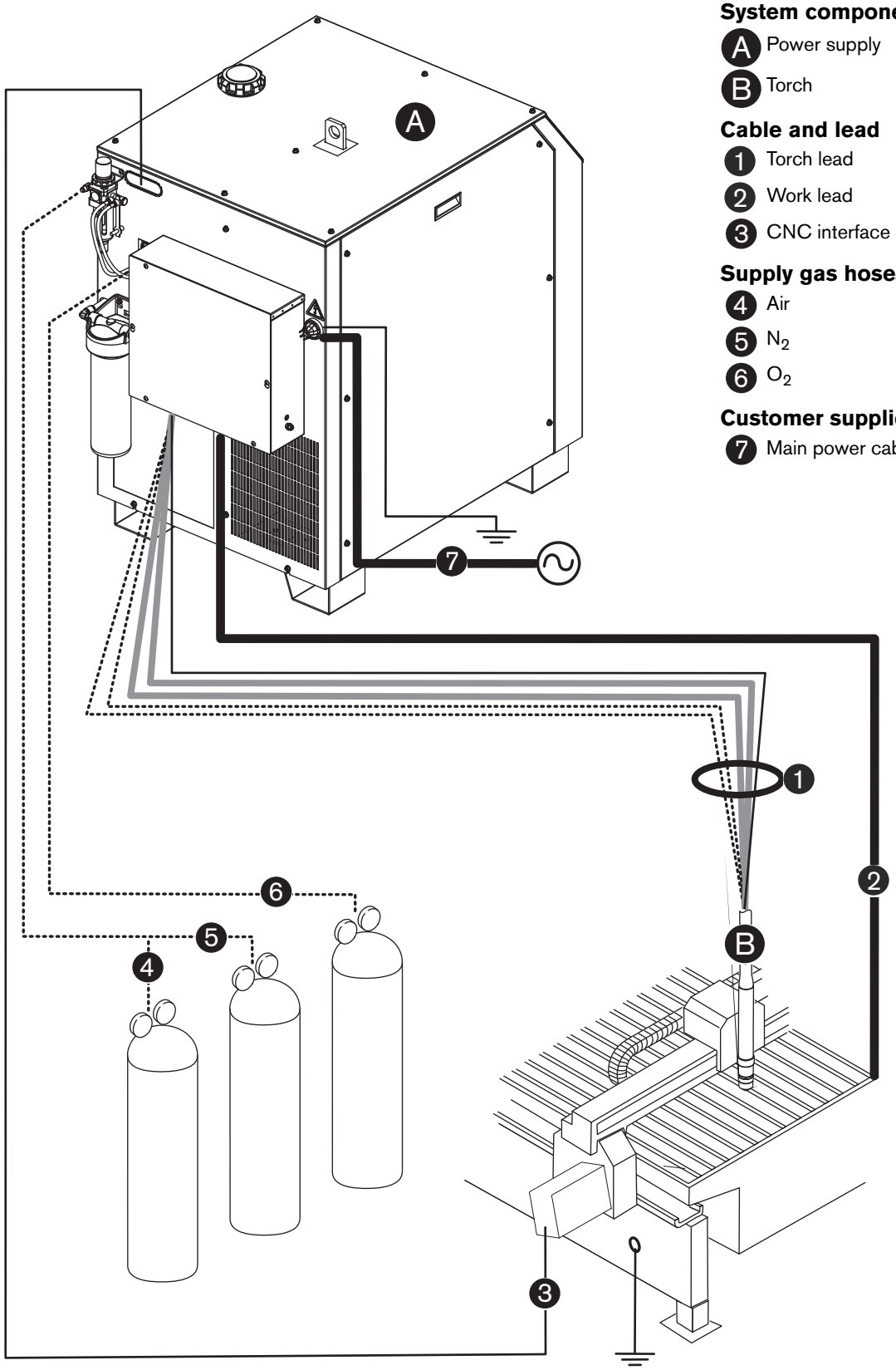
https://www.hypertherm.com/Xnet/library/DocumentLibrary.jsp

Select the product you are looking for from the Product Type drop down menu, choose “Regulatory” from the Category drop down menu, and choose “Acoustical Noise Data Sheets” from the Sub Category drop down menu. Press Submit.

Placement of system components

- Place all system components in position prior to making electrical, gas, and interface connections. Use the diagram in this section for component-placement guidelines.
- Ground all system components to earth. See *Recommended grounding and shielding practices* on page 44 for details.
- To prevent leaks in the system, tighten all gas connections as shown below.

Torque specifications			
Gas or water hose size	**kgf-cm**	**lbf-in**	**lbf-ft**
Up to 10 mm (3/8 in)	8.9–9.8	75–85	6.25–7
12 mm (1/2 in)	41.5–55	360–480	30–40



System components

A Power supply

B Torch

Cable and lead

1 Torch lead

2 Work lead

3 CNC interface cable

Supply gas hoses

4 Air

5 N_2

6 O_2

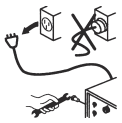
Customer supplied power cable

7 Main power cable

Recommended grounding and shielding practices

WARNING!

ELECTRIC SHOCK CAN KILL



Disconnect electrical power before performing any maintenance. All work requiring the removal of the plasma system cover must be performed by a qualified technician.

See the *Safety* section of your instruction manual for more safety precautions.

Introduction

This section describes practices for grounding and shielding to protect a plasma cutting system against radio frequency interference (RFI) and electromagnetic interference (EMI) (also called *noise*). It also describes the DC power ground and the service ground. The diagram at the end of this section shows these types of grounds in a plasma cutting system.

Note: The grounding practices in this section have been used on many installations with excellent results, and Hypertherm recommends that these practices be a routine part of the installation process. The actual methods used to implement these practices may vary from system to system, but should remain as consistent as possible. However, due to the variation in equipment and installations, these grounding practices may not succeed in every case to eliminate RFI/EMI noise issues.

Types of grounding

Service ground (also called safety ground or potential earth (PE) ground) is the grounding system that applies to the incoming line voltage. It prevents a shock hazard to any personnel from any of the equipment or the cutting table. It includes the service ground coming into the plasma system and other systems such as the CNC and the motor drives, as well as the supplemental ground rod connected to the cutting table. In the plasma circuits, the ground is carried from the plasma system chassis to the chassis of each separate console through the interconnecting cables.

DC power ground (also called cutting current ground) is the grounding system that completes the path of the cutting current from the torch back to the plasma system. It requires that the positive lead from the plasma system be firmly connected to the cutting table ground bus with a properly sized cables. It also requires that the slats, on which the workpiece rests, make firm contact with the table and the workpiece.

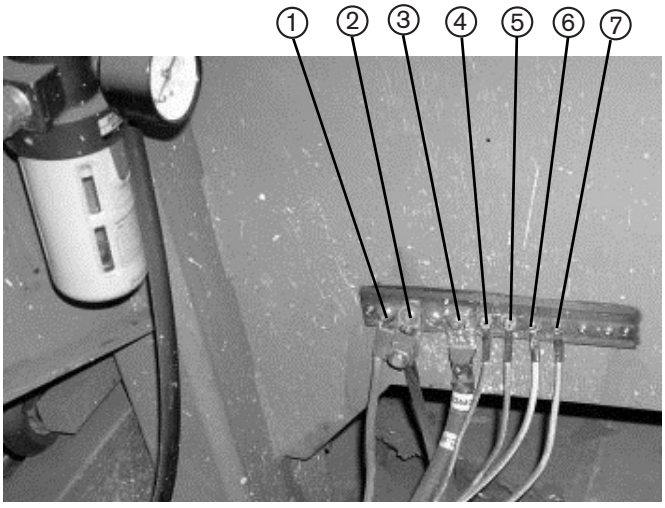
RFI and EMI grounding and shielding is the grounding system that limits the amount of electrical noise emitted by the plasma and motor drive systems. It also limits the amount of noise that is received by the CNC and other control and measurement circuits. The grounding practices described in this section mainly target RFI and EMI grounding and shielding.

Grounding practices

1. Unless noted, use only 16 mm² (6 AWG) welding cable (047040) for the EMI ground cables shown on the diagram.
2. The cutting table is used for the common, or star, EMI ground point and should have threaded studs welded to the table with a copper bus bar mounted on them. A separate bus bar should be mounted on the gantry as close to each motor as possible. If there are motors at each end of the gantry, run a separate EMI ground cable from the far motor to the gantry bus bar. The gantry bus bar should have a separate, heavy EMI ground cable 21.2 mm² (4 AWG; 047031) to the table bus bar. The EMI ground cables for the torch lifter and the RHF console must each run separately to the table ground bus.

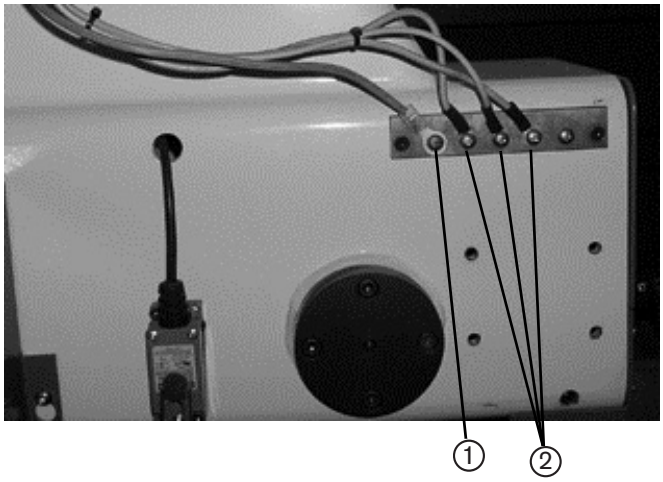
3. A ground rod that meets all applicable local and national electrical codes must be installed within 6 m (20 ft) of the cutting table. This is a PE ground and should be connected to the cutting table ground bus bar using 16 mm² (6 AWG) green and yellow grounding cable (047121) or equivalent.
4. For the most effective shielding, use the Hypertherm CNC interface cables for I/O signals, serial communication signals, between plasma systems in multi-drop connections, and for interconnections between all parts of the Hypertherm system.
5. All hardware used in the ground system must be brass or copper. While you can use steel studs welded to the cutting table for mounting the ground bus, no other aluminum or steel hardware can be used in the ground system.
6. AC power, PE, and service grounds must be connected to all equipment according to local and national codes.
7. For a system with a remote high frequency console (RHF), the positive, negative, and pilot arc leads should be bundled together for as long a distance as possible. The torch lead, work lead, and the pilot arc (nozzle) leads may be run parallel to other wires or cables only if they are separated by at least 150 mm (6 inches). If possible, run power and signal cables in separate cable tracks.
8. For a system with an RHF console, the ignition console should be mounted as closely as possible to the torch, and must have a separate ground cable that connects directly to the cutting table ground bus bar.
9. Each Hypertherm component, as well as any other CNC or motor drive cabinet or enclosure, must have a separate ground cable to the common (star) ground on the table. This includes the ignition console, whether if it is bolted to the plasma system or to the cutting table.
10. The metal braided shield on the torch lead must be connected firmly to the ignition console and to the torch. It must be electrically insulated from any metal and from any contact with the floor or building. The torch lead can be run in a plastic cable tray or track, or covered with a plastic or leather sheath.
11. The torch holder and the torch breakaway mechanism – the part mounted to the lifter, not the part mounted to the torch – must be connected to the stationary part of the lifter with copper braid at least 12.7 mm (0.5 inches) wide. A separate cable must run from the lifter to the gantry ground bus bar. The valve assembly should also have a separate ground connection to the gantry ground bus bar.
12. If the gantry runs on rails that are not welded to the table, then each rail must be connected with a ground cable from the end of the rail to the table. The rail ground cables connect directly to the table and do not need to connect to the table ground bus bar.
13. If you are installing a voltage divider board, mount it as closely as possible to where the arc voltage is sampled. One recommended location is inside the plasma system enclosure. If a Hypertherm voltage divider board is used, the output signal is isolated from all other circuits. The processed signal should be run in twisted shielded cable (Belden 1800F or equivalent). Use a cable with a braided shield, not a foil shield. connect the shield to the chassis of the plasma system and leave it unconnected at the other end.
14. All other signals (analog, digital, serial, and encoder) should run in twisted pairs inside a shielded cable. Connectors on these cables should have a metal housing. The shield, not the drain, should be connected to the metal housing of the connector at each end of the cable. Never run the shield or the drain through the connector on any of the pins.

The following picture shows an example of a cutting table ground bus. The components shown here may differ from your system.



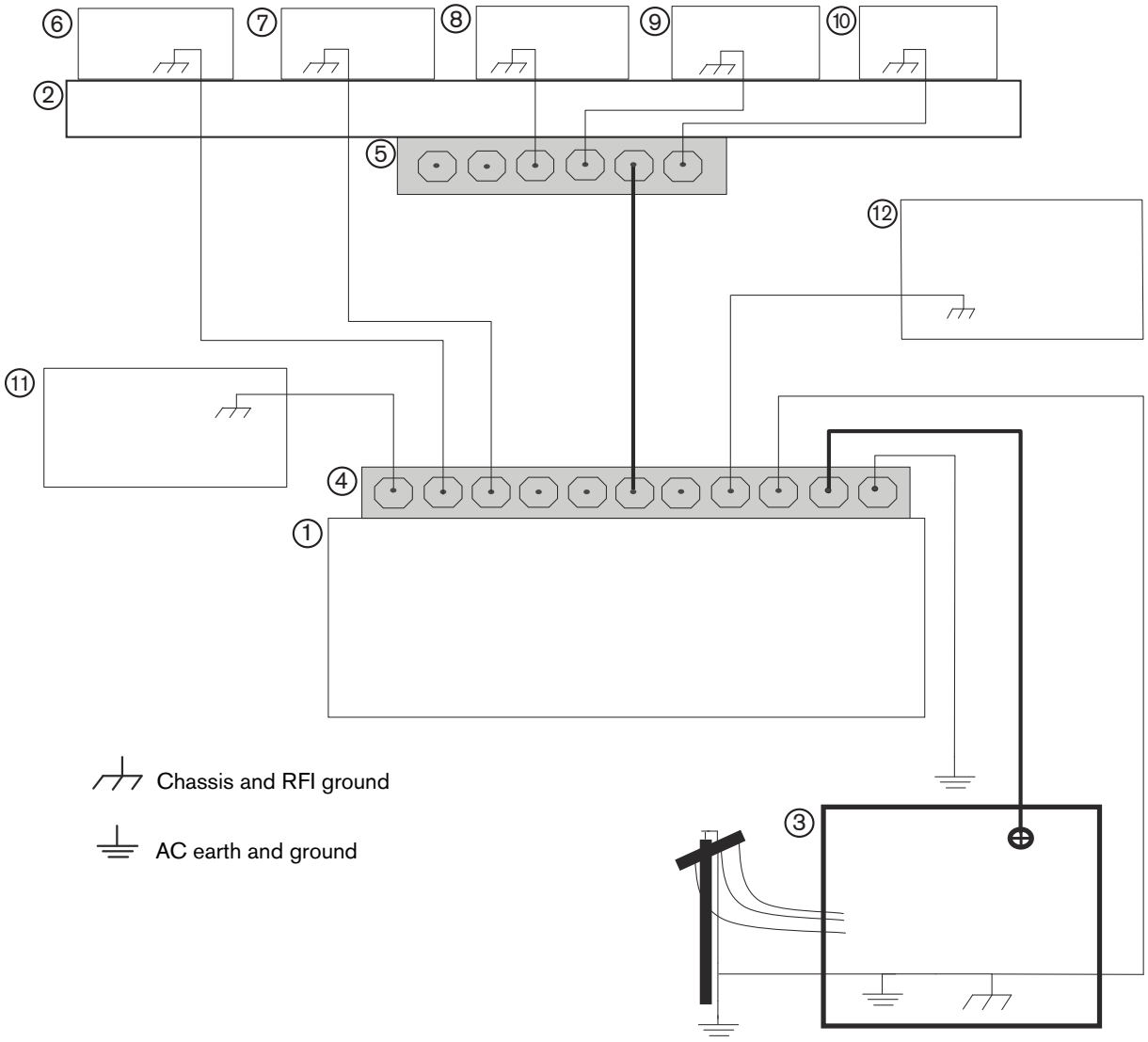
1 Gantry ground bus
2 Ground rod
3 Plasma system lead (+)
4 Remote high frequency (RHF) console
5 CNC enclosure
6 Torch holder
7 Plasma system chassis

The following picture shows an example of a gantry ground bus. It is bolted to the gantry, close to the motor. All of the individual ground cables from the components mounted on the gantry go to the bus. A single heavy cable then goes from the gantry ground bus to the table ground bus,



1 Cable to the cutting table ground bus
2 Ground cables from components on the gantry

The following diagram shows an example of grounding the components in a plasma cutting system.



1 Cutting table

2 Gantry

3 Plasma system

4 Table ground bus bar

5 Gantry ground bus bar

6 Torch height control lifter (ArcGlide, Sensor THC, Sensor PHC, or other)

7 RHF console (not on all systems). Connect to table ground bus bar.

8, 9 System-specific component such as metering console, gas console, or selection console

10 CNC chassis

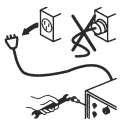
11 Torch height control module (ArcGlide, CommandTHC)

12 System-specific component such as a cooler or chiller

A Placement of the power supply

WARNING!

ELECTRIC SHOCK CAN KILL

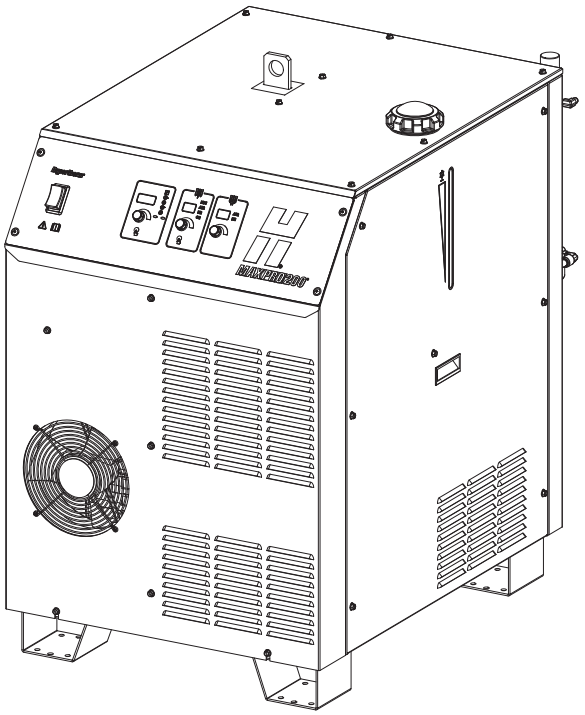


Disconnect electrical power before performing any maintenance. All work requiring the removal of the plasma system cover must be performed by a qualified technician.

See the *Safety* section of your instruction manual for more safety precautions.

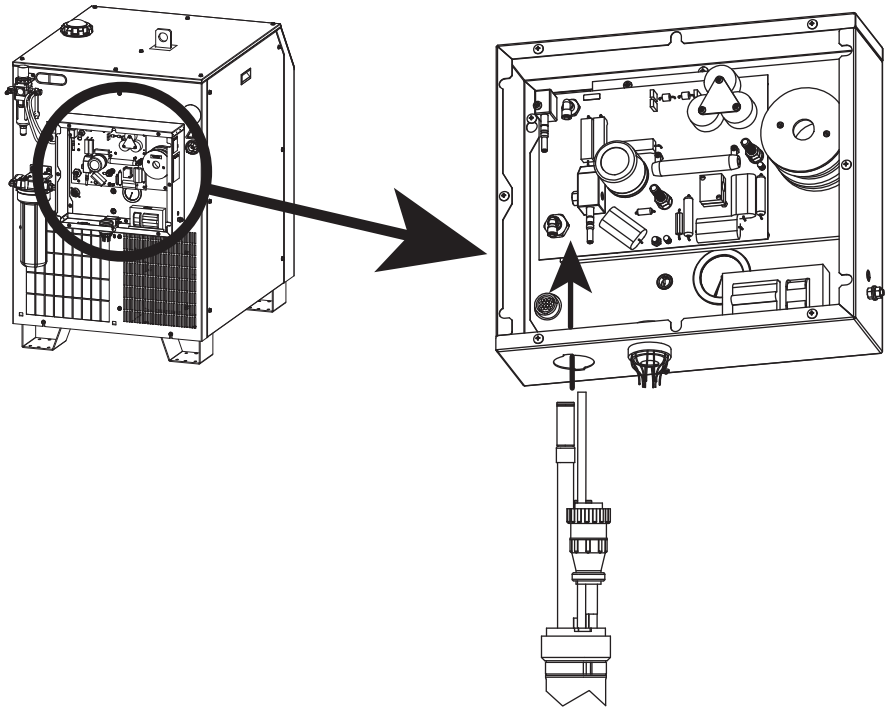
The power supply can be moved by using the lifting eye or by forklift but the forks must be long enough to extend the entire length of the base. Take care when lifting so that the underside of the power supply is not damaged. The forks must also be centered front to back and side to side to prevent tipping while moving. Fork lift speeds should be kept to a minimum, especially when making a turn or going around a corner.

- Place the power supply in an area that is free of excessive moisture, has proper ventilation and is relatively clean. Allow 1 m (3 ft) of space on all sides of the power supply for ventilation and service.
- Cooling air is drawn in through the side panel and is exhausted through the rear of the unit by a cooling fan. Do not place any filter device over the air intake locations, which reduces cooling efficiency and VOIDS THE WARRANTY.
- Do not place the power supply on an incline greater than 10° to prevent it from toppling.

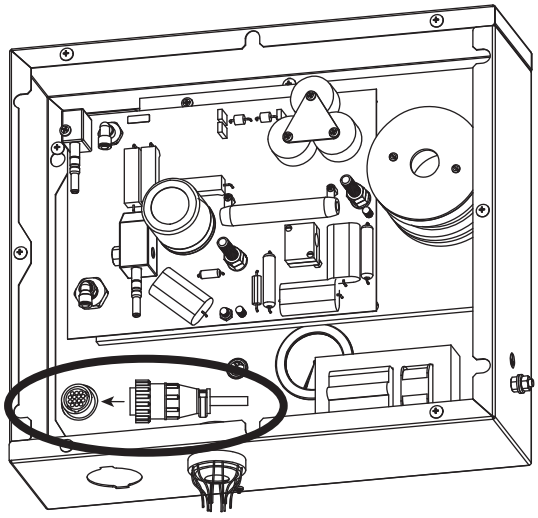


❶ Torch lead connections

1. Insert the end of the torch lead through the opening of the ignition enclosure as shown below. Secure the collar on the torch lead to the ignition enclosure by aligning the tabs on the collar with the corresponding openings in the ignition enclosure, rotate the collar until it stops, and verify that the collar will not detach when released.

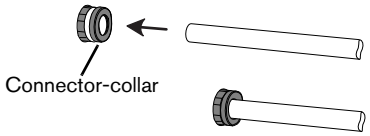


2. Connect the CPC connector to the CPC receptacle.



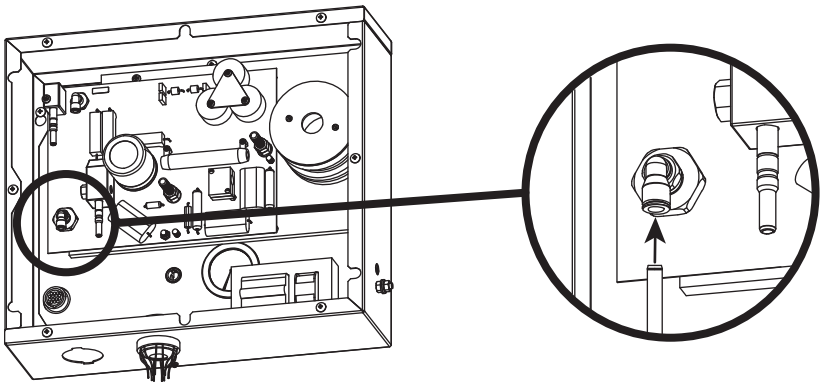
Note: The plasma gas and coolant return hose connectors mentioned below are push-to-connect fittings.

- To make a connection, push the hose fitting into the appropriate connector until it stops, 12 mm (0.472 in).

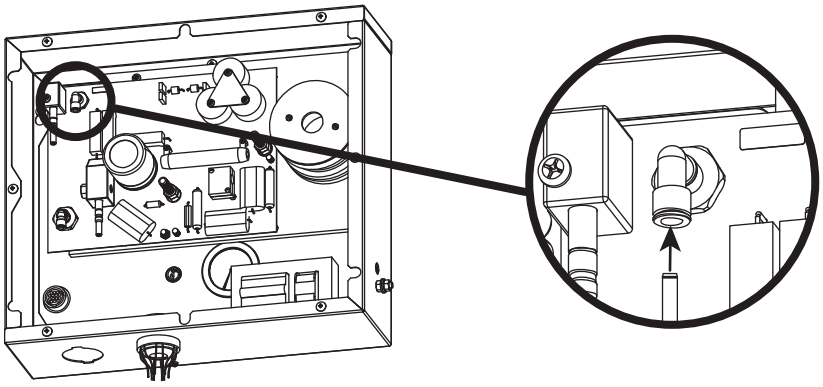


- To disconnect a fitting, push the connector-collar and hose toward the fitting, hold the collar in place and pull the hose away from the fitting.

3. Connect the coolant return hose (red).

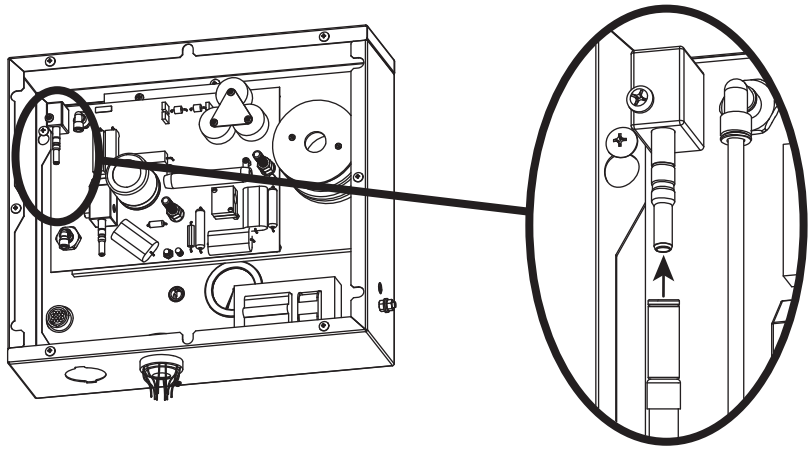


4. Connect the plasma gas hose (black).

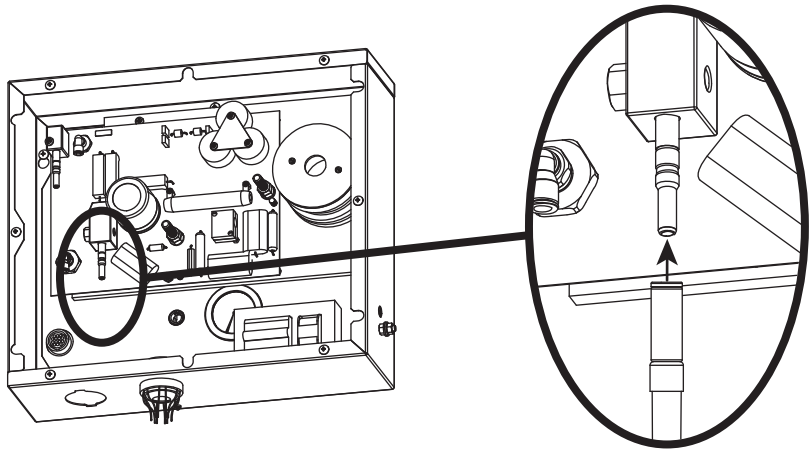


Note: The shield gas/pilot arc and coolant supply/negative lead hose connectors mentioned below are slightly different push-to-connect fittings. Slide the hose fitting over the connector and press until it clicks into place. To disconnect a fitting, pull the connector-collar toward the hose, and pull the hose away from the fitting.

5. Connect the pilot arc/shield gas hose (blue).



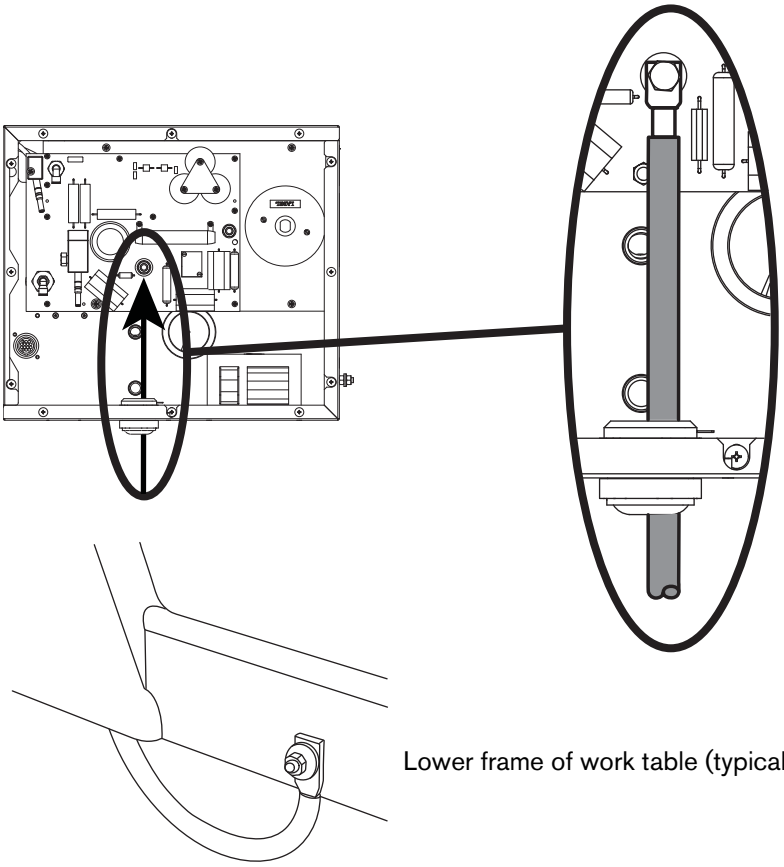
6. Connect the negative lead/coolant supply hose (blue with green tape).



❷ Work lead connections

Part number	Length
223335	7.5 m (25 ft)
223336	15 m (50 ft)
223337	23 m (75 feet)
223338	30 m (100 feet)

Remove the first nut and washer from the work lead terminal and use it to secure the work lead to the terminal.

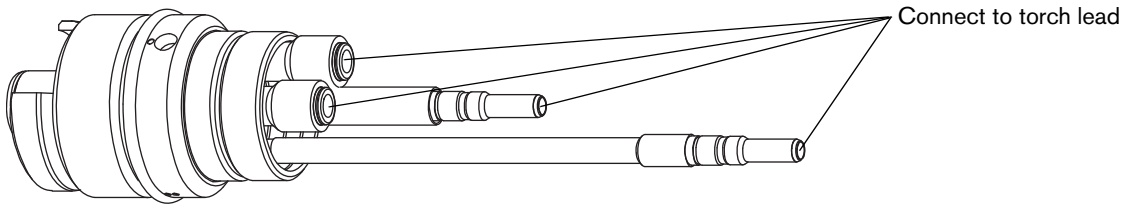


Lower frame of work table (typical)

Ⓑ Torch connections

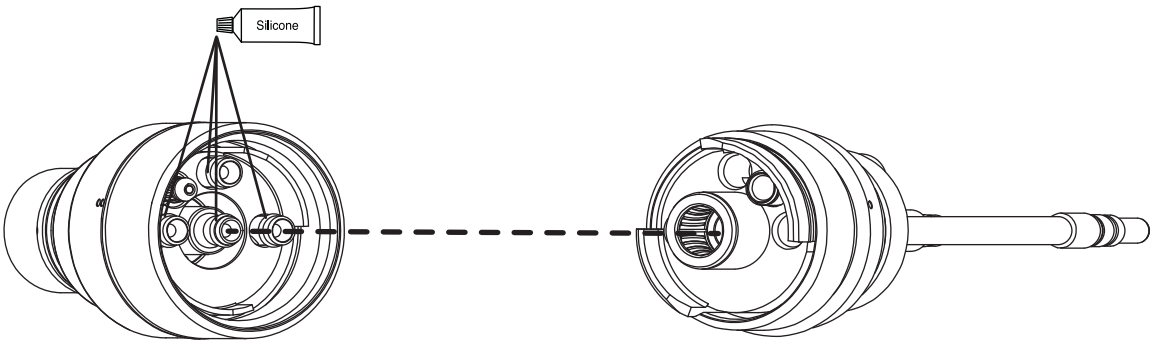
Note: The connections between the straight torch main body and the torch leads are identical to the connections between the quick-disconnect receptacle and the torch leads.

Align the quick disconnect receptacle, or the straight torch main body, to the torch leads and secure using the push-to-connect fittings.

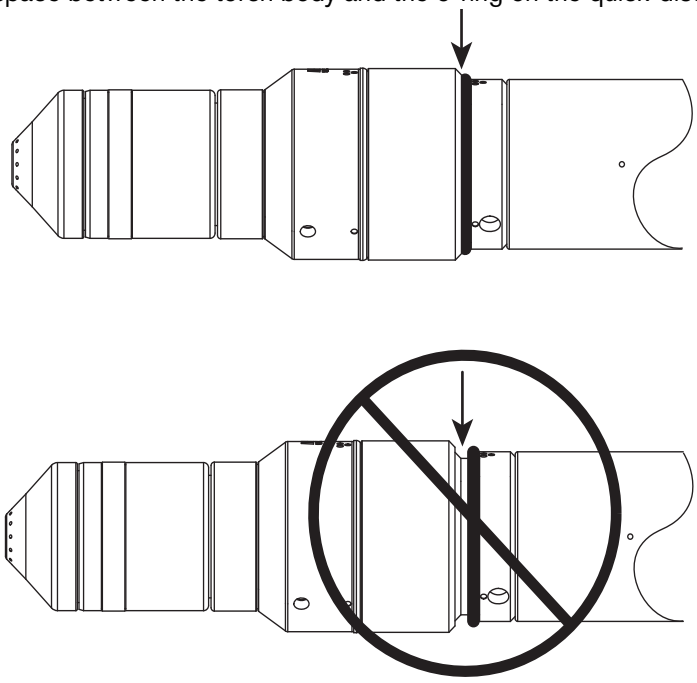


Connect the torch to the quick-disconnect receptacle

Align the torch body to the quick disconnect receptacle and connect them by screwing completely together. Apply a thin film of silicone lubricant to each o-ring. The o-rings should look shiny, but there should not be any excess or built-up lubricant.

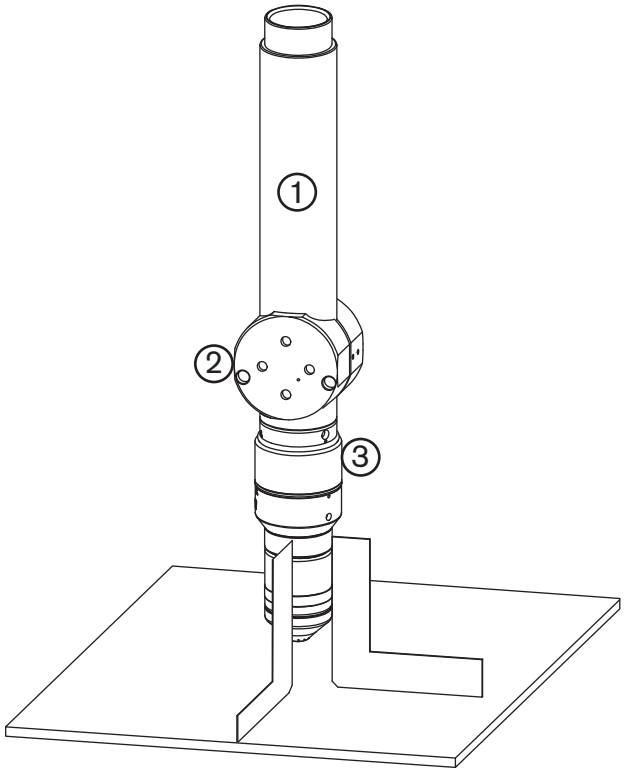


Be certain that there is no space between the torch body and the o-ring on the quick-disconnect.



Torch mounting and alignment

Mounting the torch



1	Torch sleeve
2	Mounting bracket
3	Quick-disconnect receptacle

1. Install the torch (with torch leads attached) in the torch mounting bracket.
2. Position the torch below the mounting bracket, so that the bracket is around the lower portion of the torch sleeve but not touching the torch quick-disconnect.
3. Tighten the securing screws.

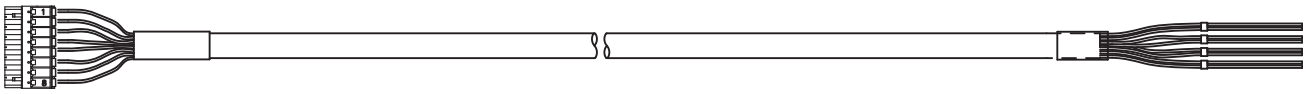
   Note: The bracket should be as low on the torch sleeve as possible to minimize vibration at the tip of the torch.

Torch alignment

To align the torch at right angles to the workpiece, use a square as shown above.

❸ CNC interface cable

Part Number	Length	Part Number	Length
223327	1.3 m (5 feet)	223330	15 m (50 feet)
223328	3.0 m (10 feet)	223331	23 m (75 feet)
223329	7.5 m (25 feet)	223332	30 m (100 feet)

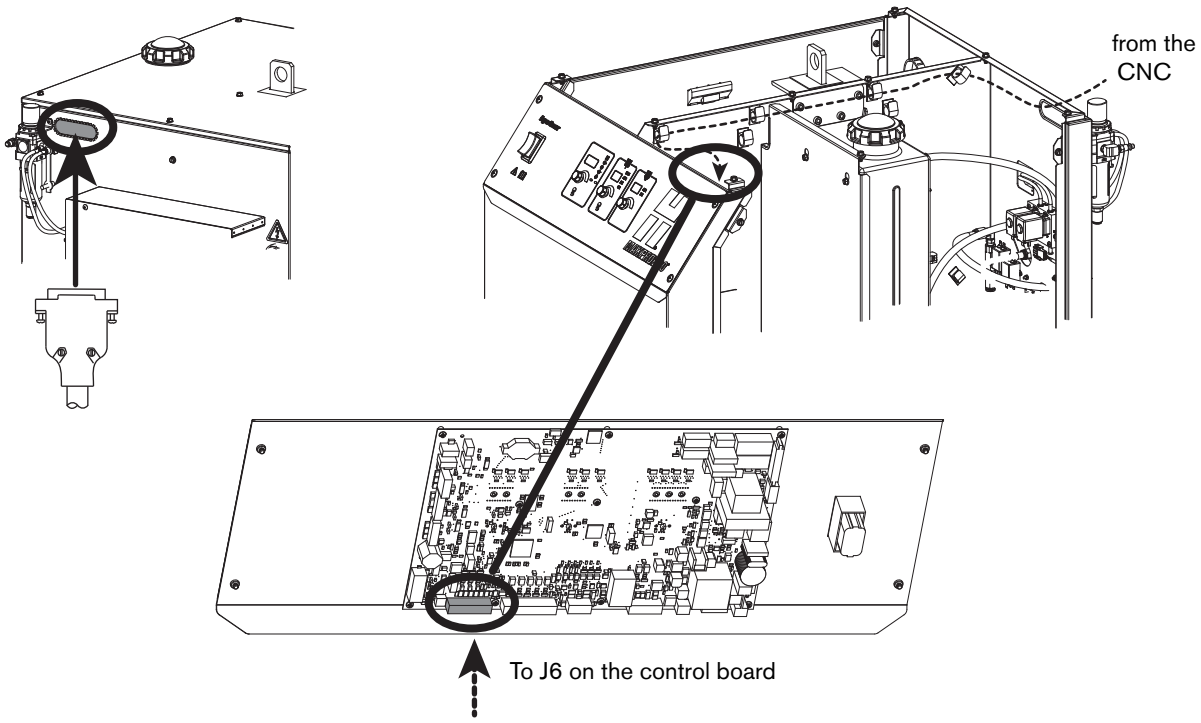


Power supply end					CNC end	
Wire color	Pin number	Input/ Output	Signal name	Function	Input/ Output	Notes
Orange	1	Input	Start +	The CNC initiates preflow, and if the hold input is not active, continues with the plasma arc. The system will stay in preflow if the hold input remains active.	Output	1
White	2	Input	Start –		Output	
Brown	3	Input	Hold +	The CNC delays plasma arc initiation. This signal is normally used in combination with the start signal to synchronize multiple torches.	Output	1 and 3
White	4	input	Hold –		Output	
Black	5	Output	Motion +	Notifies the CNC that an arc transfer has occurred and to begin machine motion once the CNC's pierce delay has timed out.	Input	2
White	6	Output	Motion –		Input	
Red	7	Output	Error +	Notifies the CNC that an error has occurred.	Input	2
White	8	Output	Error –		Input	

Notes to CNC interface cable run list

1. Inputs are optically isolated. They require 24 VDC at 12.5 mA, or dry-contact closure at 8 mA.
2. Outputs are optically isolated, open-collector, transistors. The maximum rating is 24 VDC at 10 mA.
3. Although the power supply has an output capability, it is normally used solely as an input.
4. There is no +24 VDC power available at the J6 CNC connector.
5. The wire clips on the center panel should be used to help route the CNC cable from the rear panel opening of the power supply to J6 on the control board. Open the clips by depressing the release tab, and add the CNC cable to the wires that are already present in the clip. See the figure on the next page.

CNC cable routing and connection to control board



Remote ON/OFF switch (provided by customer)

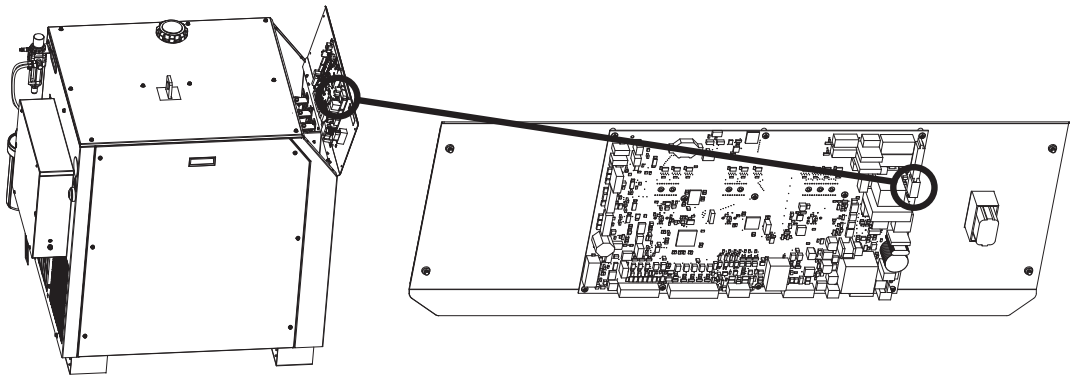
WARNING!

ELECTRIC SHOCK CAN KILL

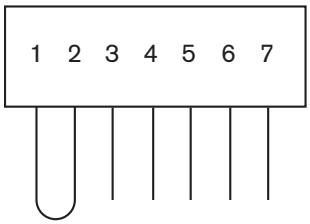
Disconnect electrical power before performing any maintenance. All work requiring the removal of the plasma system cover must be performed by a qualified technician.

See *Safety* on page 9 of your instruction manual for more safety precautions.

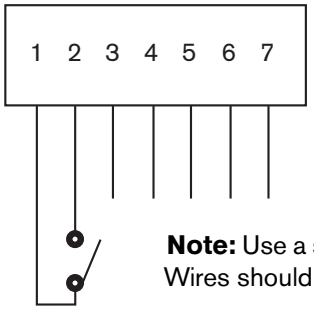
1. Remove the 4 screws that secure the control panel to the power supply and locate terminal block J1.8 on the power supply control board.



2. Remove the jumper wire between terminal 1 and terminal 2. Use a sturdy tool to depress the corresponding orange release buttons on the spring clamp connector



3. Connect the switch to terminals 1 and 2 as shown below. Use a sturdy tool to depress the corresponding orange release buttons on the spring clamp connector.



Note: Use a switch, relay, or solid-state relay that is compatible with 24 VDC @ 100 mA. Wires should be a twisted pair.

Note: The power switch on the power supply must be in the ON position for the remote switch to function and the remote switch must be in the ON position (closed) for the power switch on the power supply to function.

Power requirements

General

This equipment complies with IEC 61000-3-12 provided that the short-circuit power Ssc is greater than or equal to 5.61 MVA at the point between the user's supply and the public system. It is the responsibility of the installer or user of the equipment to ensure, by consultation with the distribution network operator if necessary, that the equipment is connected only to a supply with a short-circuit power Ssc greater than or equal to 5.61 MVA.

All switches, slow-blow fuses and power cables are customer-supplied and must be chosen as outlined by applicable national and local electrical codes. Installation must be performed by a licensed electrician. Use a separate, primary, line disconnect switch for the power supply. Recommendations on fuse and circuit breaker sizing are listed below, however actual sizes required will vary based on individual site electrical line conditions (including but not limited to: source impedance, line impedance, and line voltage fluctuation), product inrush characteristics, and regulatory requirements.

The main feed protection device (circuit breaker or fuse) must be sized to handle all branch-feed loads for both inrush and steady-state current. The power supply must be wired into one of the branch-feed circuits. The power supply has a steady-state current listed in the table below.

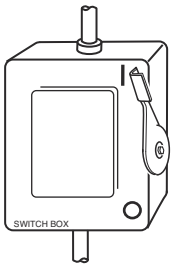
Use a motor-start circuit breaker or equivalent if time delay high inrush fuses are not permitted by local and national codes. Time delay fuses and circuit breakers must be capable of withstanding inrush current that is up to 30 times the rated input current (FLA) for 0.01 seconds and up to 12 times the rated input current (FLA) for 0.1 seconds.

Note: The table below is for reference only. All local and national electrical code must be followed.

Input voltage	Phase	Rated input current @ "X" kW output	Recommended time delay, high inrush, fuse size	Recommended cable size for 15 m (50 feet) maximum length	
				Rated for 60° C (140° F)	Rated for 90° C (194° F)
200/208 VAC	3	108/104 amps	175 amps	N/A	67.5 mm^2 (2/0)
220 VAC	3	98 amps	150 amps	85.2 mm^2 (3/0)	42.4 mm^2 (1 AWG)
240 VAC	3	90 amps	150 amps	85.2 mm^2 (3/0)	42.4 mm^2 (1 AWG)
380 VAC	3	57 amps	90 amps	33.6 mm^2 (2 AWG)	21.2 mm^2 (4 AWG)
400 VAC	3	54 amps	80 amps	26.7 mm^2 (3 AWG)	21.2 mm^2 (4 AWG)
415 VAC	3	52 amps	80 amps	26.7 mm^2 (3 AWG)	21.2 mm^2 (4 AWG)
440 VAC	3	49 amps	80 amps	26.7 mm^2 (3 AWG)	21.2 mm^2 (4 AWG)
480 VAC	3	45 amps	70 amps	21.2 mm^2 (4 AWG)	13.3 mm^2 (6 AWG)
600 VAC	3	36 amps	50 amps	13.3 mm^2 (6 AWG)	8.3 mm^2 (8 AWG)

Note: Wire AWG recommendations came from Table 310-16 of the National Electric Code Handbook (USA).

Line disconnect switch



The line disconnect switch serves as the supply-voltage disconnecting (isolating) device. Install this switch near the power supply for easy access by the operator.

Installation must be performed by a licensed electrician and according to applicable national and local codes.

The switch should:

- Isolate the electrical equipment and disconnect all live conductors from the supply voltage when in the “OFF” position
- Have one “OFF” and one “ON” position clearly marked with “O” (OFF) and “I” (ON)
- Have an external operating handle capable of being locked in the “OFF” position
- Contain a power-operated mechanism that serves as an emergency stop
- Have slow-blow fuses installed for the proper breaking capacity (see table on previous page).

❼ Main power cable

Wire sizes vary based on the temperature rating of the cable insulation and the distance of the unit from the main box. Use a 4-conductor Type SO input power cable with a conductor temperature rating of 60° C (140° F) or 90° C (194° F). Installation must be performed by a licensed electrician.

Connect the power

WARNING!

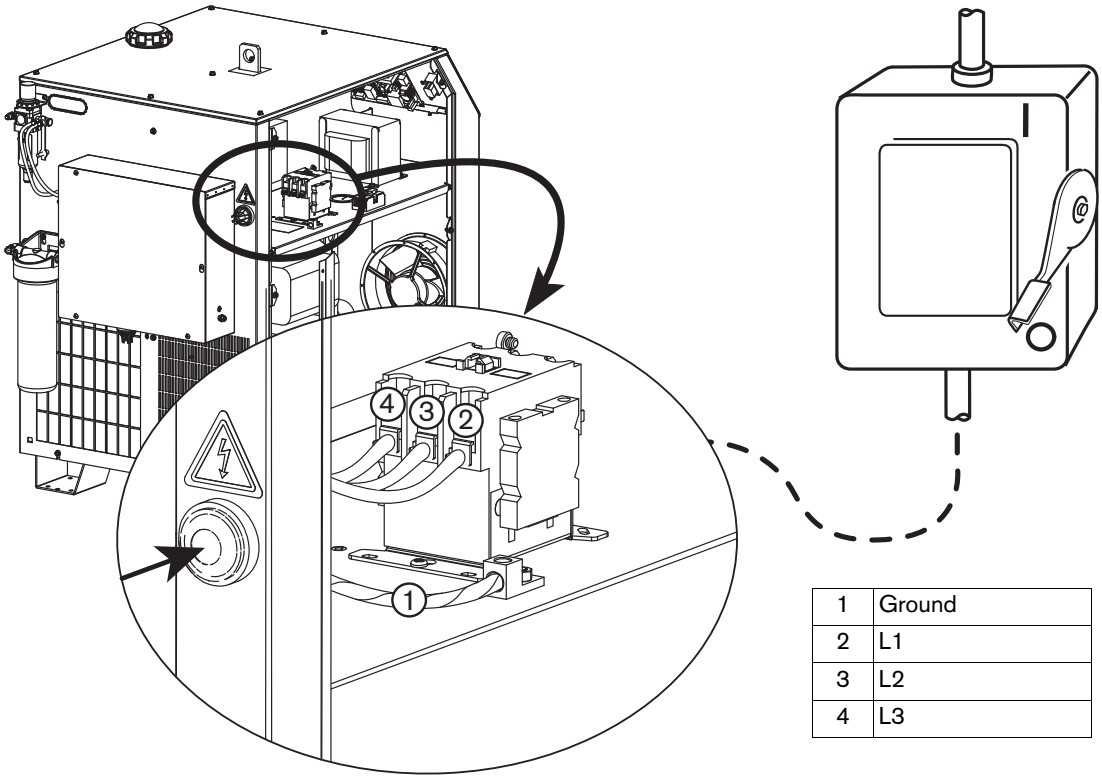
ELECTRIC SHOCK CAN KILL

The line disconnect switch must be in the OFF position before making the power cable connections. In the U.S., use a "lock-out/tag-out" procedure until installation is complete. In other countries, follow appropriate national and local safety procedures.

1. Insert the power cable through the strain relief at the rear of the power supply.
2. Connect the ground lead (PE) to the GROUND connector as shown below.
3. Connect the power leads to the contactor terminals as shown below. For models with an EMI filter, connect the power leads to the EMI filter terminal block. Recommended torque on contactor or EMI filter terminals is 7-8 Nm (60–70 in-lbs).
4. **Verify that the line disconnect switch is in the OFF position and remains in the OFF position for the remainder of the installation of the system.**
5. Connect the power cord leads to the line disconnect switch following national and local electrical codes.

North American wire colors
U = Black
V = White
W = Red
(PE) Earth ground = Green/yellow

European wire colors
U = Black
V = Blue
W = Brown
(PE) Earth ground = Green/yellow



1	Ground
2	L1
3	L2
4	L3

Torch coolant requirements

The system is shipped without any coolant in the tank. Before filling the coolant system, determine what coolant mix is correct for your operating conditions.

Observe the warning and cautions below. Refer to the *Material Safety Data Sheets* appendix for data on safety, handling and storage of propylene glycol and benzotriazole.

WARNING!

COOLANT CAN BE IRRITATING TO SKIN AND EYES AND HARMFUL OR FATAL IF SWALLOWED.

Propylene glycol and benzotriazole are irritating to skin and eyes, and harmful or fatal if swallowed. Upon contact, flush skin or eyes with water. If swallowed, seek immediate medical attention.

CAUTION!

Never use automotive antifreeze in place of propylene glycol. Antifreeze contains corrosion inhibitors that will damage the torch coolant system.

Always use purified water in the coolant mixture to prevent damage to the pump and corrosion in the torch coolant system.

Premixed coolant for standard operating temperatures

Use Hypertherm premixed coolant (028872) when operating in a temperature range of -12° C to 40° C (10° F to 104° F). Refer to the custom coolant mix recommendations, if temperatures during operation are ever outside of this range.

Hypertherm premixed coolant consists of 69.8% water, 30% propylene glycol, and 0.2% benzotriazole.

Custom Coolant mix for cold operating temperatures (below -12° C / 10° F)

CAUTION!

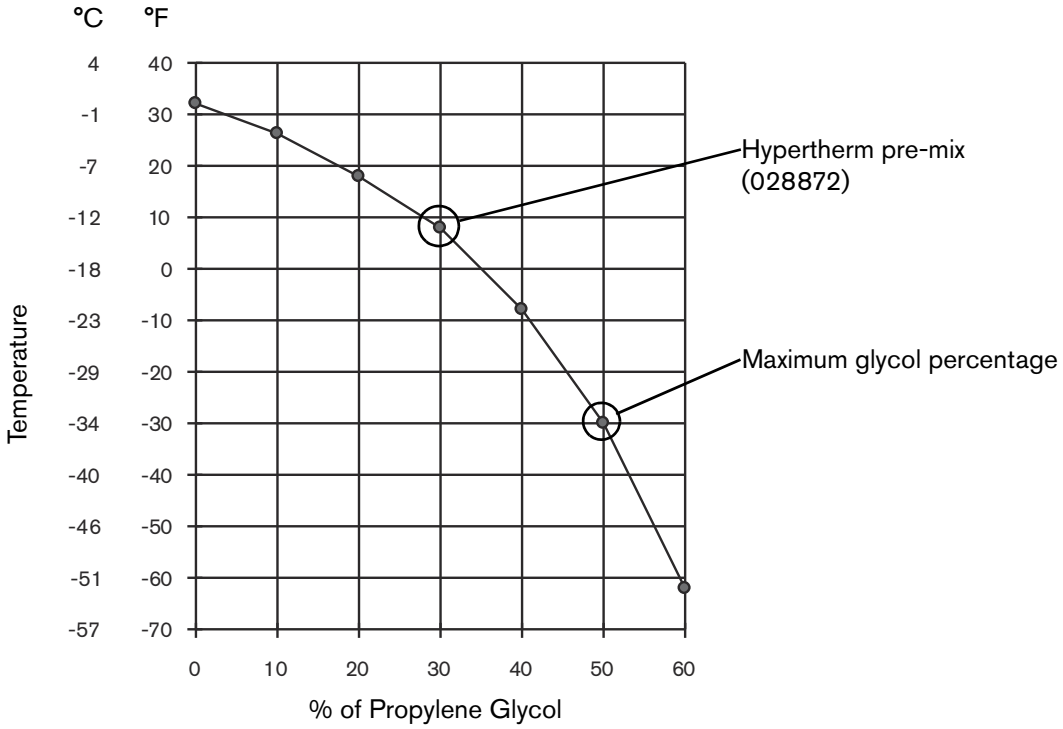
For operating temperatures colder than the temperature stated above, the percentage of propylene glycol must be increased. Failure to do so could result in a cracked torch head, hoses or other damage to the torch coolant system due to freezing.

Use the chart below to determine what percentage of propylene glycol to use in the mixture.

Mix 100% propylene glycol (028873) with the premixed Hypertherm coolant (028872) to increase the percentage of glycol in the premixed Hypertherm coolant. The 100% glycol solution can also be mixed with purified water (see the chart below for water purity requirements) to achieve the required protection from freezing.

Note: The maximum percentage of propylene glycol should never exceed 50%.

Freezing Point of Propylene Glycol Solution



Custom Coolant mix for hot operating temperatures (above 38° C / 100° F)

Treated water (with no propylene glycol) can only be used as coolant when operating temperatures are never below 0° C (32° F). For operations in very warm temperatures, treated water will provide the best cooling properties.

Treated water refers to a mixture of purified water, that meets the specifications below, and 1 part benzotriazole (BZT) to 300 parts of water. BZT (128020) acts as a corrosion inhibitor for the copper based coolant system contained in the plasma system.

Water purity requirements

It is critical to maintain a low level of calcium carbonate in the coolant to avoid reduced performance of the torch or cooling system.

Always use water that meets the minimum and maximum specifications in the table below when using a custom coolant mix.

Water that does not meet the minimum purity specifications below can cause excessive deposits on the nozzle that will alter the water flow and produce an unstable arc.

Water that does not meet the maximum purity specifications below can also cause problems. Deionized water that is too pure will cause leaching problems with the coolant system plumbing.

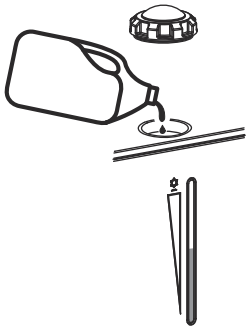
Use water purified by any method (deionization, reverse osmosis, sand filters, water softeners, etc.) as long as the water purity meets the specifications in the table below. Contact a water specialist for advice in choosing a water filtration system.

	Water purity measurement method			
Water purity	Conductivity µS/cm at 25° C (77° F)	Resistivity mΩ-cm at 25° C (77° F)	Dissolved solids (ppm of NaCl)	Grains per gallon (gpg of CaCO2)
Pure water (for reference only)	0.055	18.3	0	0
Maximum purity	0.5	2	0.206	0.010
Minimum purity	18	0.054	8.5	0.43
Maximum potable water (for reference only)	1000	0.001	495	25

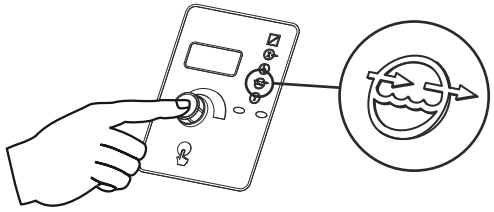
Fill the power supply with coolant

The system will take 14.2 liters to 17.0 liters (3.75 to 4.5 gallons) of coolant depending on the length of the torch leads.

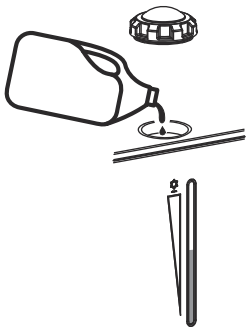
1. Add coolant to the power supply until the tank is full.



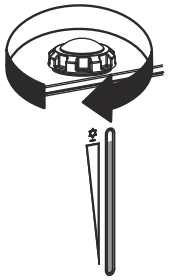
2. Turn ON the power supply, then press and release the amps selector knob as many times as needed until the flow symbol is selected. The flow rate will be shown in the three digit display. There is a 45 second delay before the system will report a low coolant flow error. If the flow rate has not reached 1.9 liters per minute (lpm) (0.5 gallons per minute [gpm]) the system will turn off the pump.



3. If the system displays an error, turn OFF the power to the system and add coolant to the tank until it is full again. Repeat steps 2 and 3 until no error is displayed.



4. Add coolant to the power supply until the tank is full and replace the filler cap.

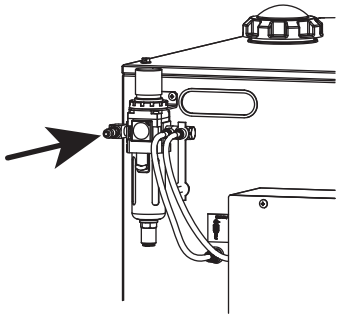


Connect the supply gases

Air/air cutting

Note: Verify that the plasma gas line and the shield gas line are properly connected before connecting the air supply hose and supplying pressurized gas to the system.

Connect the air supply hose to the filter regulator as shown below.

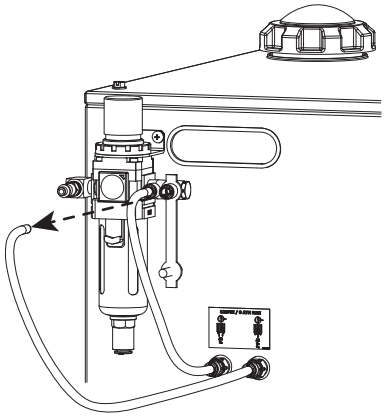


N_2/N_2 supply gas connection

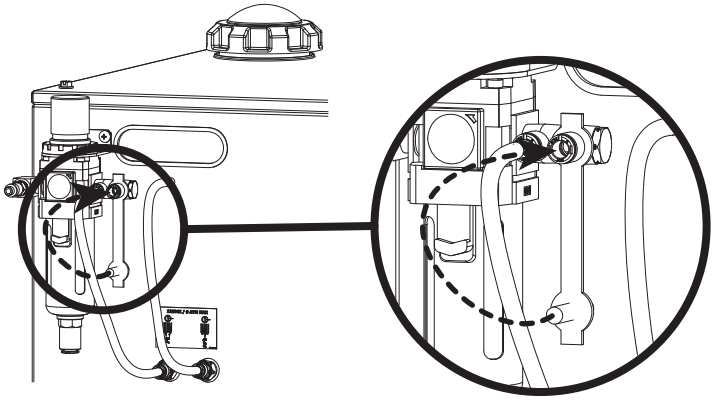
1. Disconnect the air supply hose from the filter regulator.
2. Remove the Air fitting 015012 (1/4 inch NPT X #6 MALE) from the filter/regulator.
   a. Install an 015103 adaptor to use the nitrogen supply gas hose offered by Hypertherm.
   b. Use the 1/4 inch NPT Female port from which the air fitting was removed to connect a user supplied N_2 supply gas hose.
3. Set the gas pressure regulators. See *Setting the supply gas regulators* on page 71.

O_2/Air Supply gas hook up

1. Disconnect the air supply from the system.
2. Remove the plasma supply tube from filter/regulator output port.



3. Use the supplied plug to block the open plasma outlet port of the filter/regulator.

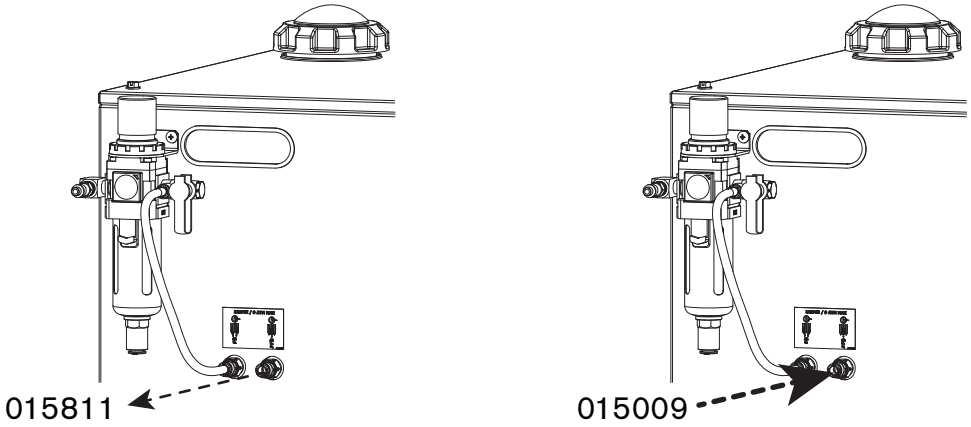


4. Connect only filtered and regulated oxygen to the plasma gas Inlet. See *Gas regulators* on page 72 for a suitable oxygen regulator.

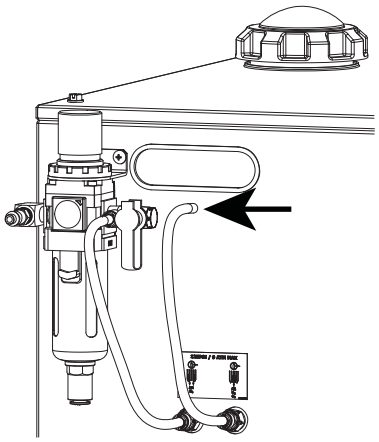
   Note: An oxygen fitting kit (428054) with the parts described below is available from Hypertherm.

There are several options for connecting the oxygen supply gas line:

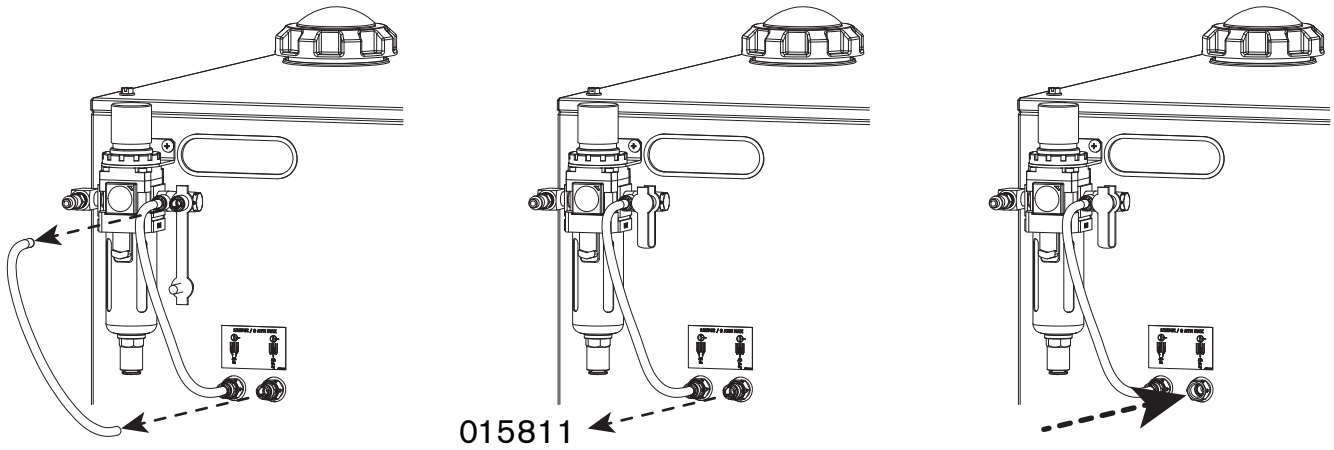
   a. Remove the 015811 fitting and put on an 015009 fitting (user must order the part. See the note above). Use the correct Hypertherm supply gas tubing (046231) to connect to the fitting.



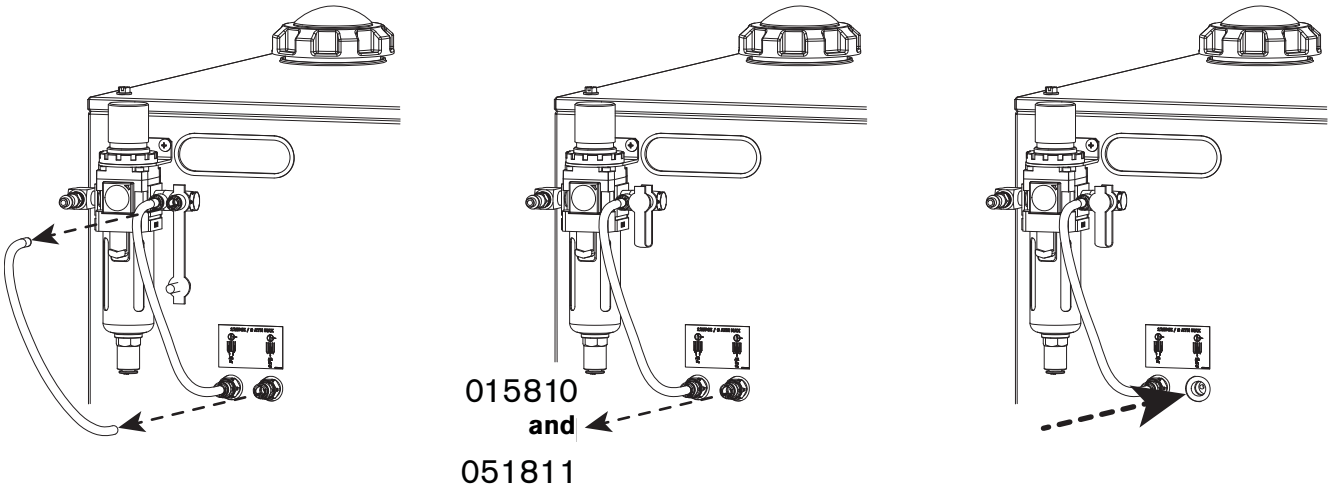
b. Use a suitable O_2 fitting to connect to the 8 mm (5/16 inch) tubing that you removed from the plasma gas Inlet.



c. Remove the plasma gas tubing and 8 mm (5/16 inch) fitting (015811) and connect to the 1/4 inch NPT female threads.



d. Remove the bushing and fitting to connect to 1/4 inch “G” female threads.



5. Reconnect the air supply.
6. Set the gas pressure regulators. See *Setting the supply gas regulators* on page 71.

Gas requirements

The system is configured for air/air cutting when it is shipped. Connect an air supply to the filter/regulator that is mounted on the rear panel of the power supply. If cutting with O_2/air or N_2/N_2 you will have to make changes to the gas connections. See *Connect the supply gases* on page 67.

CAUTION!

Gas supply pressures not within the specifications in Section 2 can cause poor cut quality, poor consumable life, and operational problems.

If the purity level of the gas is too low, or if there are leaks in the supply hoses or connections:

- **Cut speeds can decrease**
- **Cut quality can deteriorate**
- **Cutting thickness capability can decrease**
- **Parts life can shorten**

Setting the supply gas regulators

1. Turn OFF the power to the system. Set all the supply gas regulator pressures to 6.2 bar (90 psi).
2. Turn ON the power to the system.
3. After the purge cycle is complete, press the current selection knob to get to the test mode. When the test mode icon is illuminated, turn the knob to get to test 005, “Flow gas at full pressure”. Set all supply regulators to a system inlet pressure of 6.2 bar (90 psi).
4. Press and release the current selection knob until the amps icon is illuminated.

Gas regulators

Note: A separate gas regulator is needed only when cutting with oxygen.

Use a high-quality, 1-stage, gas regulator to maintain consistent gas supply pressure, if using liquid cryogenic or bulk storage. Use a high-quality, 2-stage, gas regulator to maintain consistent gas supply pressure from high pressure gas cylinders.

The high-quality gas regulators listed below are available from Hypertherm and meet U.S. Compressed Gas Association (CGA) specifications. In other countries, select gas regulators that conform to national or local codes.

2-stage regulator

1-stage regulator

Part number	Description
128544	Kit: Oxygen 2-stage regulator*
128548	Kit: Oxygen 1-stage regulator (for use with cryogenic liquid nitrogen or oxygen)
022037	2-stage oxygen regulator
* Kit includes the 2-stage regulator (022037) and the appropriate fittings	

Supply gas plumbing

- Rigid copper plumbing or suitable flexible hose may be used for all gas supplies.
- Do not use steel, black iron, or aluminum pipe.
- After installation, pressurize the entire system and check for leaks.
- Recommended hose diameters are 9.5 mm (3/8 in) for lengths < 23 m (75 ft) and 12.5 mm (1/2 in) for lengths > 23 m (75 ft).

For flexible-hose systems, use a hose designed for inert gas to carry air or nitrogen. See *Supply gas hoses* on page 74 for part numbers.

Caution: Never use teflon tape

Caution: When connecting oxygen to the power supply, make sure that all hoses, hose connections, and fittings are acceptable for use with oxygen. Installation must be made in accordance with national and local codes.

Note: When cutting with oxygen as the plasma gas, air must also be connected to the filter regulator.

WARNING!

CUTTING WITH OXYGEN CAN CAUSE FIRE OR EXPLOSION

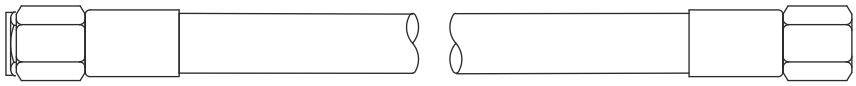
Cutting with oxygen as the plasma gas can cause a potential fire hazard due to the oxygen-enriched atmosphere that it creates. As a precaution, Hypertherm recommends that an exhaust ventilation system be installed when cutting with oxygen.

Flashback arrestors are required (unless not available for specific gases or required pressures) to prevent fire from propagating back to supply gas.

Supply gas hoses

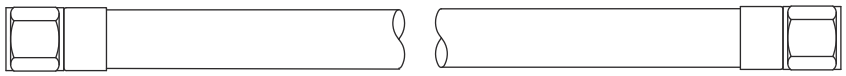
Caution: Never use teflon tape

❹ Air



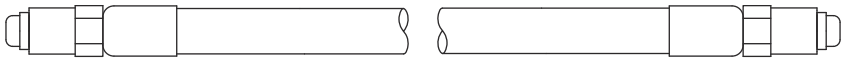
Part number	Length	Part number	Length
024671	3 m (10 ft)	024740	25 m (82 ft)
024658	4.5 m (15 ft)	024744	35 m (115 ft)
024659	7.5 m (25 ft)	024678	45 m (150 ft)
024765	10 m (35 ft)	024680	60 m (200 ft)
024660	15 m (50 ft)	024767	75 m (250 ft)
024766	20 m (65 ft)		

❺ Oxygen



Part number	Length	Part number	Length
024607	3 m (10 ft)	024738	25 m (82 ft)
024204	4.5 m (15 ft)	024450	35 m (115 ft)
024205	7.5 m (25 ft)	024159	45 m (150 ft)
024760	10 m (35 ft)	024333	60 m (200 ft)
024155	15 m (50 ft)	024762	75 m (250 ft)
024761	20 m (65 ft)		

❻ Nitrogen



Part number	Length	Part number	Length
024210	3 m (10 ft)	024739	25 m (82 ft)
024203	4.5 m (15 ft)	024451	35 m (115 ft)
024134	7.5 m (25 ft)	024120	45 m (150 ft)
024211	10 m (35 ft)	024124	60 m (200 ft)
024112	15 m (50 ft)	024764	75 m (250 ft)
024763	20 m (65 ft)		

Daily start-up

Before turning on the power to the system make sure that the cutting environment and clothing worn by users in that environment meet all the safety requirements outlined in *Safety* on page 9.

DANGER!

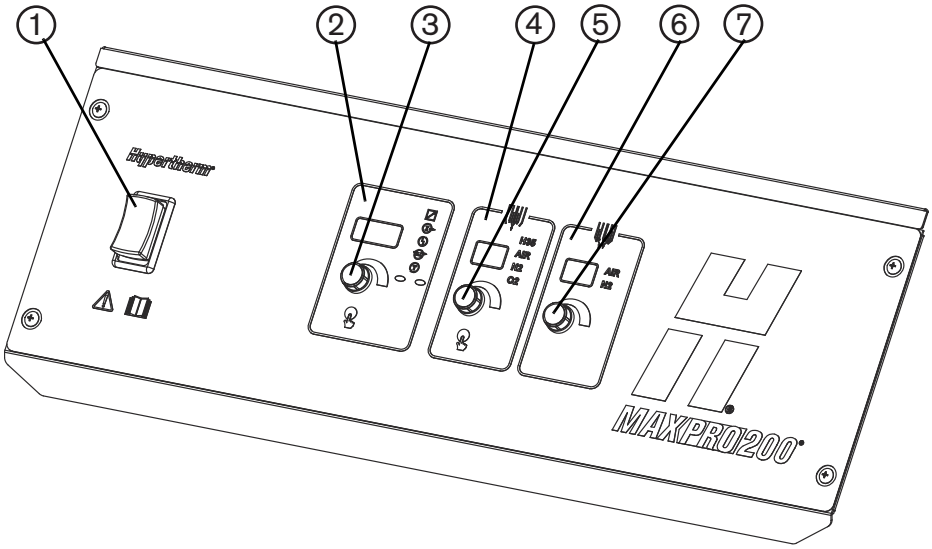
ELECTRIC SHOCK CAN KILL

Before operating this system, you must read the *safety* section thoroughly. Turn OFF the power supply's main disconnect switch before proceeding with the following steps.

1. Turn OFF the main disconnect switch to the power supply.
2. Remove the consumables from the torch and check for worn or damaged parts. **Always place the consumables on a clean, dry, oil-free surface after removing. Dirty consumables can cause the torch to malfunction and can shorten the life of the coolant pump.**
   - *See Install and inspect consumables on page 90* for details.
   - Refer to *Cut charts* to choose the correct consumables for your cutting needs.
3. Replace consumable parts. *See Install and inspect consumables on page 90* for details.
4. Make sure that the torch is perpendicular to the workpiece.

1	Shield	4	Swirl ring
2	Nozzle retaining cap	5	Electrode
3	Nozzle	6	Torch main body (quick-disconnect torch shown)

Controls and indicators



Control panel descriptions	
1	Power switch
2	3-digit display area
3	Current selection knob
4	2-digit plasma display area
5	Plasma gas knob
6	2-digit shield display area
7	Shield gas knob

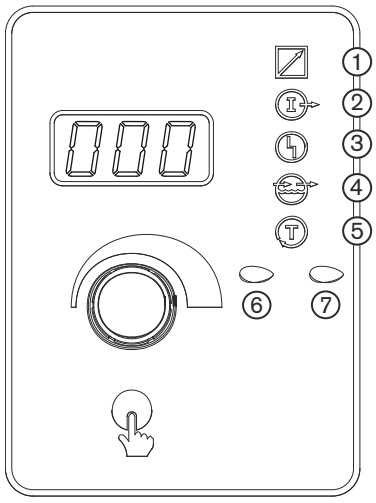
Power supply operation

General

- The system runs a number of tests automatically when the system is turned ON. See *Automatic chopper and current sensor tests during power-up* on page 152.
- There is power to the control board and other non-high power components when the main disconnect switch is on, even if the switch on the Power Supply is off. The switch is illuminated to indicate that there is power to the system. Non-high power components include the low power control circuitry in the chopper, but not the high-power IGBTs which are switched by the contactor.
- The 3-digit display counts from 1 to 6 to indicate the 6 second purge that occurs when you turn ON the power supply (you will only actually see 1 thru 5). If the system is powered up with the start signal on, the 3-digit display will continue to count up.
- When you turn ON the power to the system the displays shows the last process used.
- The user can lock out all inputs (current, plasma gas, and shield gas) to the system by pressing and holding both the amps and shield gas control knobs until LOC appears in the 3-digit display. The same process unlocks the system and ULC appears in the 3-digit display. The user can still cycle through the functions in the 3-digit display area (current, fault, coolant flow, and test).
- All three displays show actual values during cutting. The user can make changes to the current, the plasma gas, and the shield gas settings unless the inputs have been locked out or the system is being controlled remotely. The displays show the set values when idle.
- A blinking red dot appears in the bottom right corner of each display when the parameters have been changed from the default setting.

3-digit display functions

Turn the current selection knob to increase or decrease the amperage. Push and release the current selection knob to move from one function to the next.

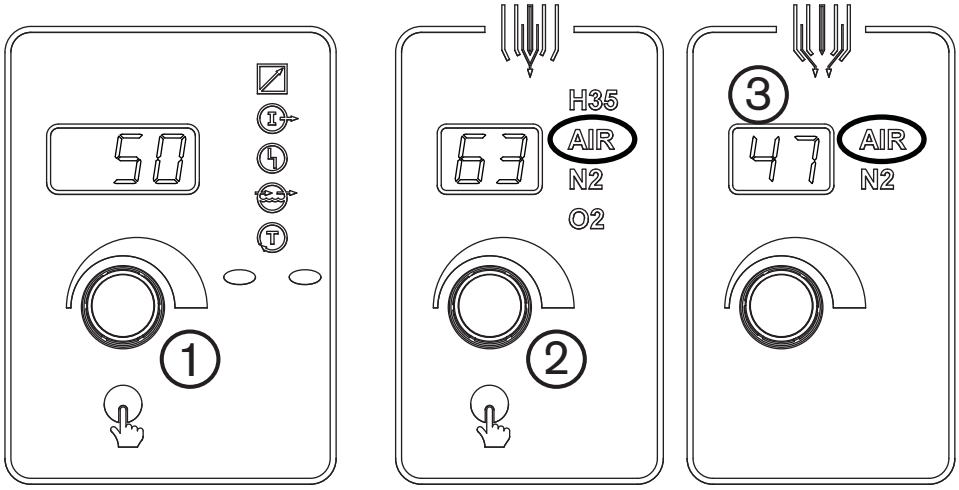


3-digit display icons	
Name	**Description**
1 Remote	The remote icon illuminates when there is serial communication with the power supply. You can still cycle through the functions but cut parameters can only be changed through the CNC.
2 Amps	Increase or decrease the amperage by selecting the amps icon and turning the knob. The current increases or decreases in 1 amp increments when you turn the knob slowly. You can jump from one process amperage to another when you turn the knob quickly.
3 Fault	The fault icon illuminates when an error occurs. If the error code number is 60 or less, press the current selection knob to navigate to the illuminated fault icon. When the fault icon is selected the error code appears in the 3-digit display. If the error code is 60 or greater the system automatically selects the fault icon and the error code number flashes in the 3-digit display. Press and hold the current selection knob to see the power supply status number for both types of error code.
4 Coolant flow	When the coolant flow icon is selected the display shows the coolant flow in gallons per minute. When you turn ON the power to the system and select the coolant flow icon before the power supply finishes the purge count, the flow switch is overridden and coolant will continue to flow for 30 seconds.
5 Test	When test icon is selected the system is in test mode. A number of functions can be accessed by turning the current selection knob. See the maintenance section for detailed information.
6 Plasma start lamp	This white lamp illuminates when the plasma start signal is given and stays illuminated until the start signal is removed.
7 Arc transfer lamp	This green lamp illuminates when the arc transfers to the workpiece.

Choosing a cutting process

1. Use the current selection knob to set the amperage. Turning the knob slowly increases or decreases the current 1 amp at a time. Turning the knob fast lets you jump quickly to the next process current (50A, 130A, and 200A). A blinking red dot appears in the bottom right corner of each display when the parameters have been changed from the default setting. You can return to the default setting by pressing and releasing the knob until you return to the original selection.
2. Push and release the plasma gas knob to cycle through the plasma gas selections. The pressure will automatically be set when you choose a gas. Turning the knob increases or decreases the pressure. A blinking red dot appears in the bottom right corner of each display when the parameters have been changed from the default setting. You can return to the default setting by pressing and releasing the knob until you return to the original gas selection.
3. The shield gas pressure is set automatically when you choose a plasma gas. Turning the knob increases or decreases the pressure. A blinking red dot appears in the bottom right corner of each display when the parameters have been changed from the default setting. You can return to the default setting by pressing and releasing the knob until you return to the original gas selection.

   Note: The example shown below is the 50 amp, mild steel, air/air process. See the cut chart for details.



CAUTION!

SPARKS AND HOT METAL CAN INJURE EYES AND BURN SKIN. When firing the torch, sparks and hot metal will spray out from the nozzle. Point the torch away from yourself and others. Always use the proper protective equipment. See *Safety* on page 9 for more information.

Handheld cutting

Specifications

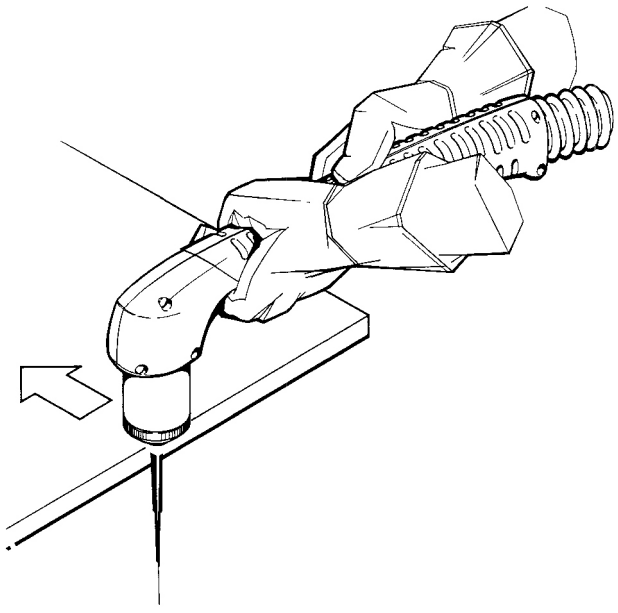
Materials	Mild steel, stainless steel, and aluminum
Current	50A, 130A, and 200A
Plasma gas types	Air, O_2, N_2
Shield gas types	Air, N_2
Torch weight (without lead)	See *Specifications* on page 33

Consumable selection and gas settings

Refer to *Cutting parameters on page 86* for consumable and process information.

Starting a cut

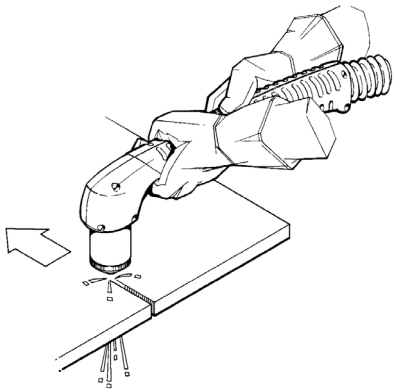
1. Start cutting from the edge of the workpiece (see figure below) unless you must pierce. For the best results, the nozzle orifice should overlap the edge of the workpiece about halfway, and the torch (arc) axis should be perpendicular to the cut surface.



Note: When cutting, make sure that the sparks are coming out of the bottom of the workpiece. If they are spraying on top of the workpiece, you are moving the torch too fast, or you do not have sufficient power to fully penetrate the workpiece.

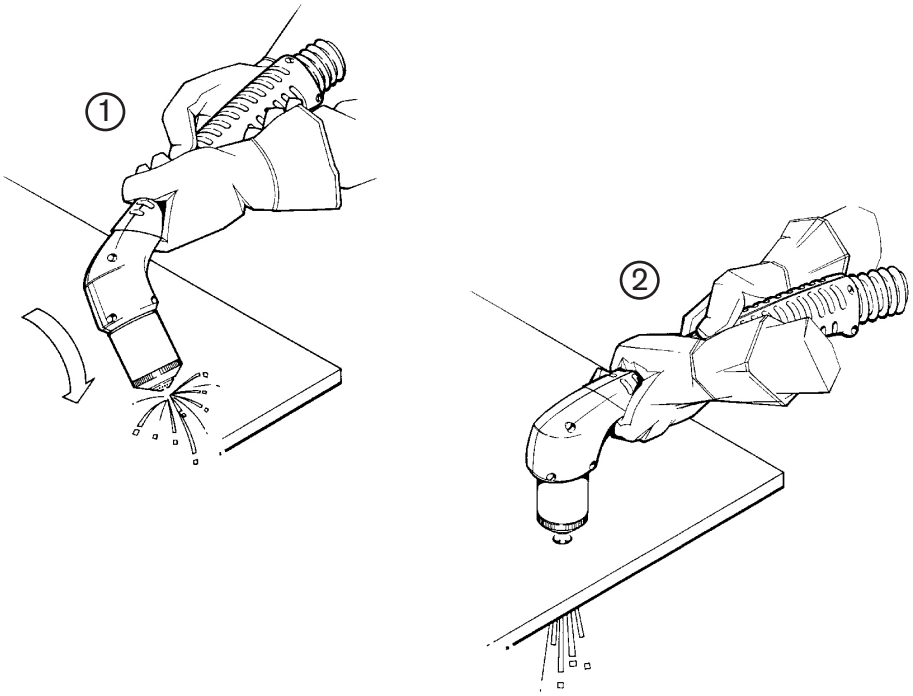
2. Hold the torch lightly on the metal or just off the metal and drag the torch across the metal. The arc transfers once the torch is within 6 mm (1/4 inch) of the workpiece.

3. Pull the torch through the cut. Pulling it is easier than pushing it.
4. Hold the torch so the arc is vertical and watch the arc as it cuts along the line (see figure below). By lightly dragging the shield on the workpiece, you can maintain a steady cut. For straight-line cuts, use any straight edge as a guide.



Piercing

1. Start by holding the torch so that the shield is approximately 1.5 mm (1/16 inch) away from the workpiece before squeezing the trigger switch. This method maximizes the life of the consumables. See figures below.
2. Hold the torch at about a 45° angle to the workpiece pointing away from yourself, then slowly roll it to a vertical position. This is particularly important when cutting thicker material. Make sure that the torch is pointed away from you and the people around you to avoid any danger from sparks and hot metal. Starting the pierce at an angle permits the hot metal to escape to one side rather than splashing back against the shield, protecting the operator from the sparks and extending the life of the shield.
3. When the pierce is complete, proceed with the cut.



Gouging

Specifications

Materials	Mild steel, stainless steel, and aluminum
Current	200 Amps
Plasma gas types	Air, O_2
Shield gas types	Air
Torch weight (without lead)	See the *Specification* section

Gouging safety

When gouging, it is absolutely necessary to wear full protection:

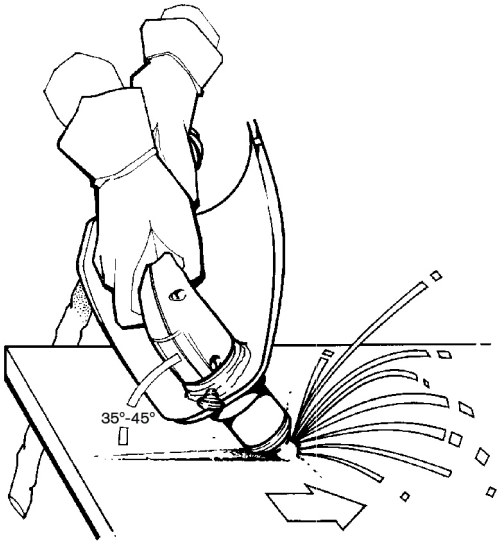
- A welding helmet with at least a #12 glass
- Welding gloves and a welding jacket.
- A heat shield (127389) can be purchased for further protection.

Gouge a workpiece

Note: To choose the correct consumables see *Hand held cutting and gouging consumable selection on page 87*.

1. Hold the torch so that the torch tip is within 1.5 mm (1/16 inch) from the workpiece before firing the torch.
2. Hold the torch at a 45° angle to the workpiece with a small gap between the torch tip and the workpiece. Press the trigger to obtain a pilot arc. Transfer the arc to the work piece.
3. Maintain an approximate 45° angle to the workpiece as you feed into the gouge. Push the plasma arc in the direction of the gouge you want to create. Keep a small distance between the torch tip and the molten metal to avoid reducing consumable life or damaging the torch.

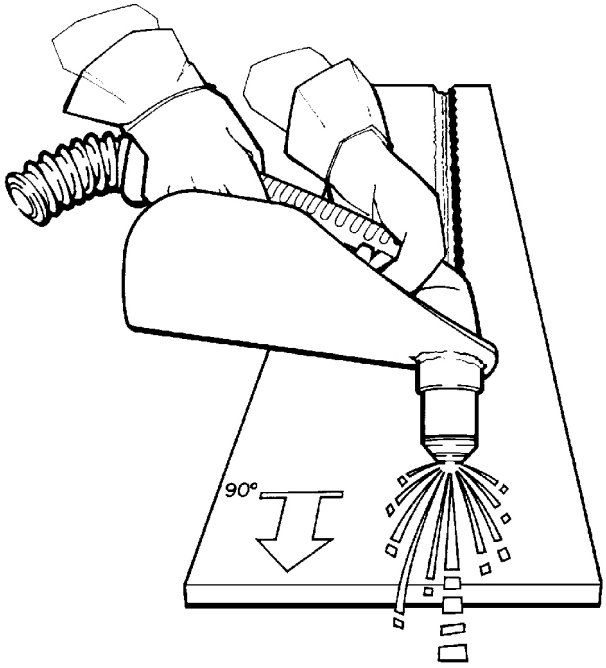
   Note: Changing the torch's angle changes the dimensions of the gouge.



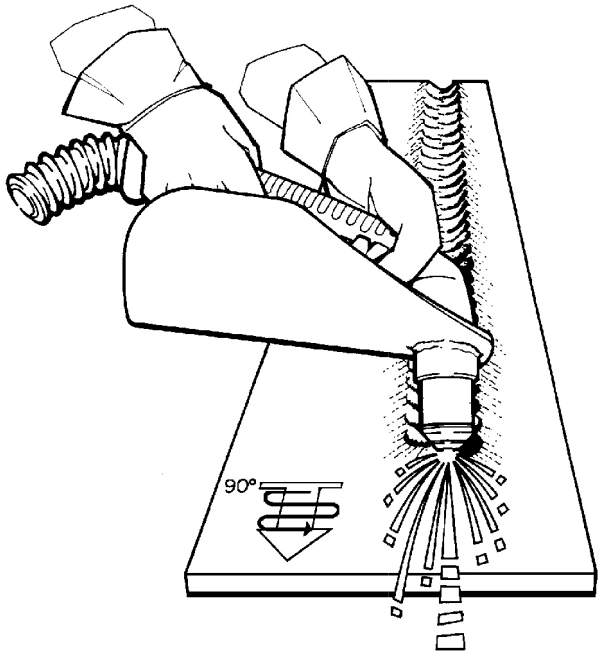
Feeding into the gouge

Gouging techniques

Straight gouging

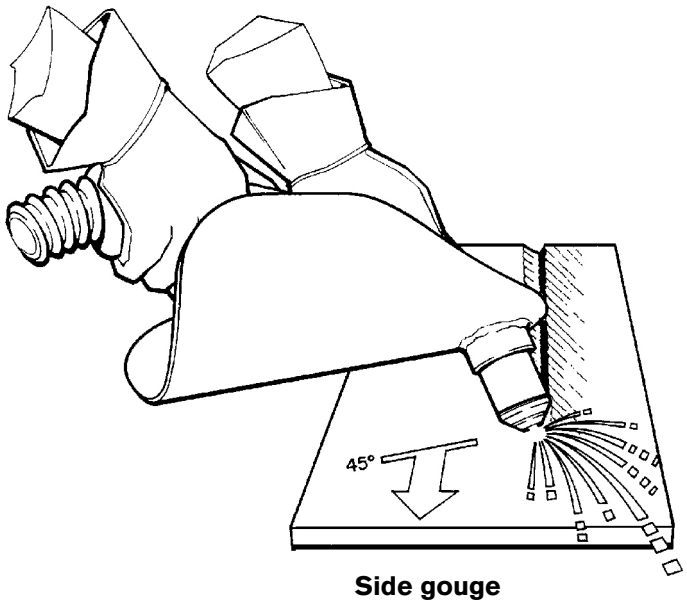


Straight gouge

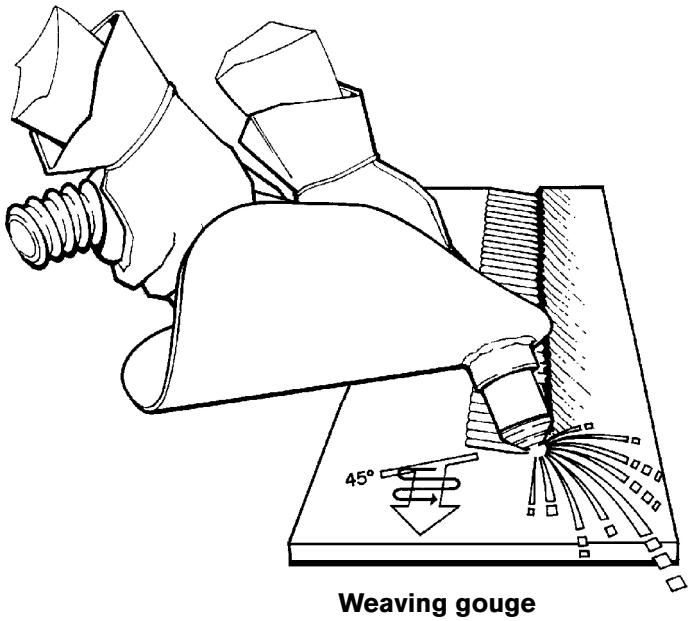


Weaving gouge

Side gouging

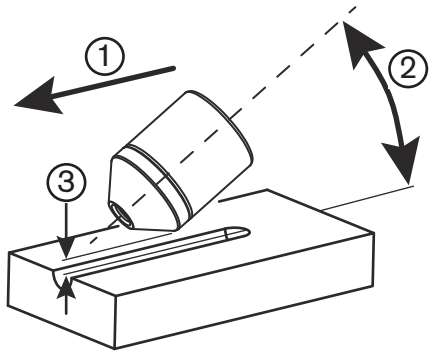


Side gouge



Weaving gouge

Gouge profiles and metal removal rates



Operating parameters		
1	Speed	635 to 1270 mm/minute (25 to 50 ipm)
2	Angle	35 to 45 degrees
3	Standoff	12.7 to 19.0 mm (0.5 to 0.75 inches)
	Maximum arc stretch	76 mm (3 inches)*
*For infrequent use, not 100% duty cycle		

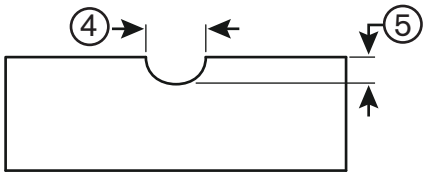
Typical gouge profile for 200A, air

Metal removal rate on mild steel – 18.7 Kg/hr (41.2 lbs/hr)

Speed 1270 mm/min (50 ipm)

Stand off 12.7 mm (0.5 inch)

Angle 35°



4	10.7 mm (0.42 inches)
5	4.4 mm (0.18 inches)

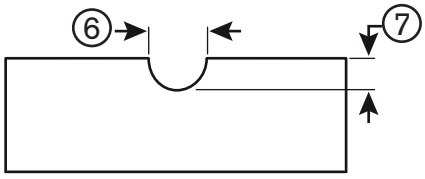
Typical gouge profile for 200A, O_2

Metal removal rate on mild steel – 20.5 Kg/hr (45 lbs/hr)

Speed 1270 mm/min (50 ipm)

Stand off 12.7 mm (0.5 inch)

Angle 35°



6	10.4 mm (0.41 inches)
7	5.4 mm (0.21 inches)

Varying the gouge profile

You can vary the gouge profile and the metal removal rate by varying the speed of the torch over the workpiece, varying the distance between the torch and the workpiece, varying the angle of the torch to the workpiece, and varying the current output of the power supply.

The following actions have the stated effects on the gouge profile:

- **Increasing the speed** of the torch will **decrease width** and **decrease depth**.
- **Decreasing the speed** of the torch will **increase width** and **increase depth**.
- **Increasing the standoff** of the torch will **increase width** and **decrease depth**.
- **Decreasing the standoff** of the torch will **decrease width** and **increase depth**.
- **Increasing the angle** of the torch (more vertical) will **decrease width** and **increase depth**.
- **Decreasing the angle** of the torch (less vertical) will **increase width** and **decrease depth**.
- **Increasing the current** of the power supply will **increase width** and **increase depth**.
- **Decreasing the current** of the power supply will **decrease width** and **decrease depth**.

Cutting parameters

The cut charts for the MAXPRO200 show the consumable parts, cutting speeds, and the gas and torch settings required for each process, allowing for differences in the lead length. These parameters are used for cutting with both mechanized and handheld torches, the consumable part numbers listed with each cut chart are specific to mechanized torches. Refer to *Hand held torch consumables* below for the consumables to use with handheld torches.

The cut chart values in this document are recommended to provide high quality cuts with minimal dross. Because of differences between installations and material composition, adjustments may be required to obtain desired results.

Mechanized consumables

The consumable part numbers listed above each cut chart are specific to mechanized torches.

Hand held torch consumables

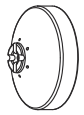
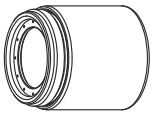
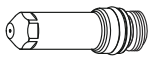
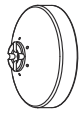
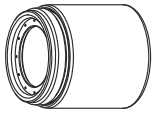
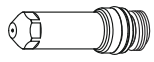
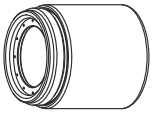
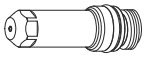
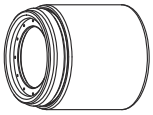
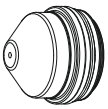
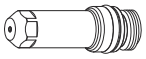
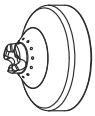
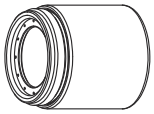
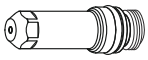
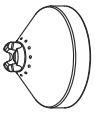
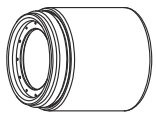
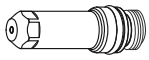
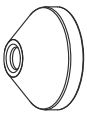
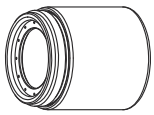
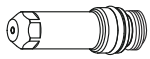
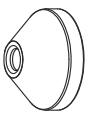
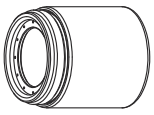
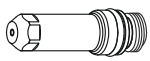
The following sets of consumables are intended to be used with handheld torches for cutting mild steel, stainless steel, and aluminum. Use the cutting parameters detailed in the *Cut charts* for cutting with the MAXPRO200 handheld torches. Use the following consumables for each process.

Hand held cutting and gouging consumable selection

The following sets of consumables are intended to be used with handheld torches for cutting mild steel, stainless steel, and aluminum. You can use the cutting parameters detailed under *Cut charts* on page 101 with the MAXPRO200 handheld torches as long as you use the following consumables for each process.

Note: consumable part numbers listed above each cut chart are specific to mechanized torches.

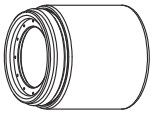
Mild steel

50 A Air Plasma Air Shield	 420063	 220935	 220890	 220529	 220528
50 A O_2 Plasma Air Shield	 420063	 220935	 220891	 220529	 220528
130 A Air Plasma Air Shield	 420061	 220935	 220892	 220488	 220487
130 A O_2 Plasma Air Shield	 420062	 220935	 220893	 220488	 220487
200 A Air Plasma Air Shield	 420058	 220935	 420044	 220488	 220937
200 A O_2 Plasma Air Shield	 420059	 220935	 220831	 220834	 220937
200 A Gouging Air Plasma Air Shield	 420067	 220935	 420066	 220488	 220937
200 A Gouging O_2 Plasma Air Shield	 420067	 220935	 420066	 220834	 220937

Stainless steel

50 A
Air Plasma
Air Shield

420063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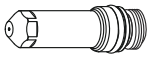
220890

220529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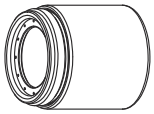
130 A
Air Plasma
Air Shield

420061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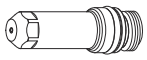
220892

220488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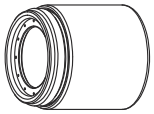
130 A
N_2 Plasma
N_2 Shield

420061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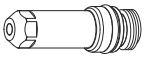
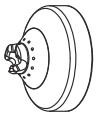

020415

200 A
Air Plasma
Air Shield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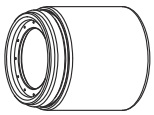
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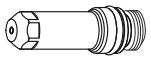
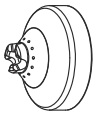
420044

220488


220937

200 A
N_2 Plasma
N_2 Shield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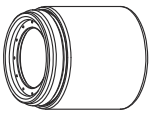
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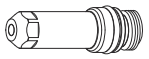
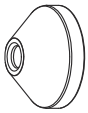
420044

220488


020415

200 A Gouging
Air Plasma
Air Shield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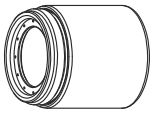
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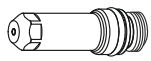
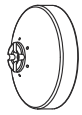
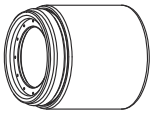
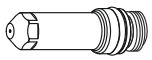
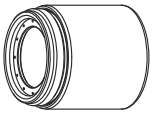
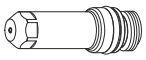
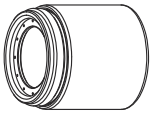
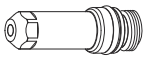
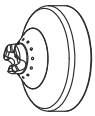
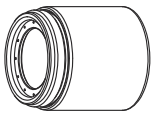
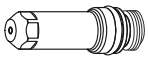
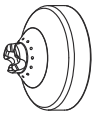
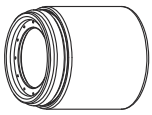
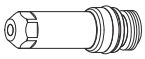
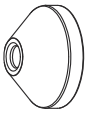
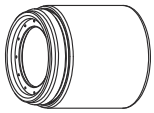
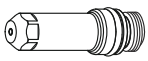
420066

220488


220937

Aluminum

50 A Air Plasma Air Shield	 420063	 220935	 220890	 220529	 220528
130 A Air Plasma Air Shield	 420061	 220935	 220892	 220488	 220487
130 A N_2 Plasma N_2 Shield	 420061	 220935	 220892	 220488	 020415
200 A Air Plasma Air Shield	 420058	 220935	 420044	 220488	 220937
200 A N_2 Plasma N_2 Shield	 420058	 220935	 420044	 220488	 020415
200 A Gouging Air Plasma Air Shield	 420067	 220935	 420066	 220488	 220937

Install and inspect consumables

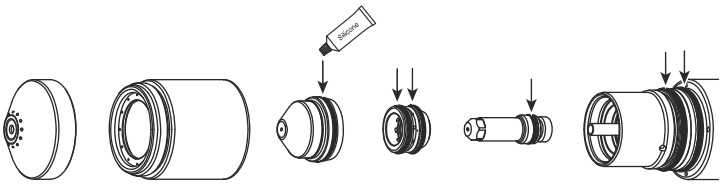
WARNING!

Always disconnect power to the power supply before inspecting or changing torch consumable parts. Use gloves when removing consumables. The torch might be hot.

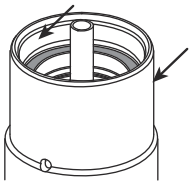
Install consumables

Check the consumable parts daily for wear before cutting. See *Inspect consumables* on page 91. Before removing consumables, bring the torch to the edge of the cutting table, with the torch lifter raised to its highest point to prevent the consumables from dropping into the water of the water table.

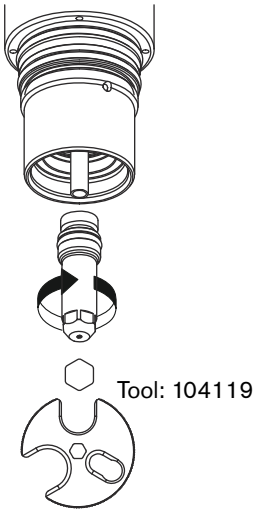
Do not overtighten parts! Only tighten until mating parts are seated.



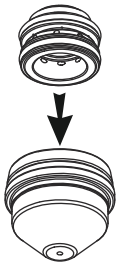
Apply a thin film of silicone lubricant on each o-ring. The o-ring should look shiny, but there should not be any excess or built-up lubricant.



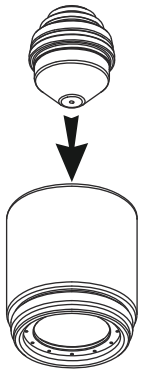
Wipe the internal and external surfaces of the torch with a clean cloth or paper towel.



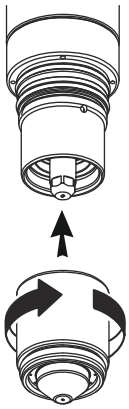
1. Install the electrode into the torch head



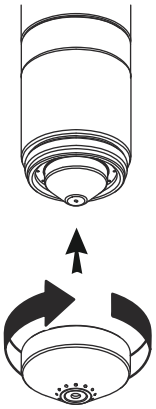
2. Install the swirl ring into the nozzle



3. Install the nozzle and swirl ring into the nozzle retaining cap

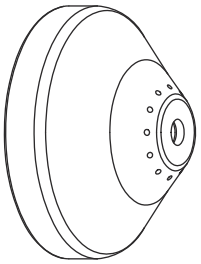
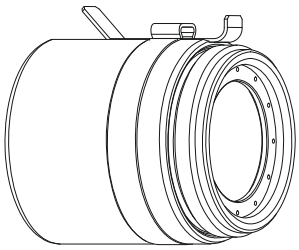
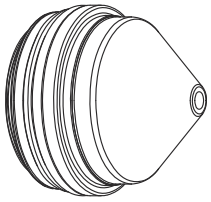
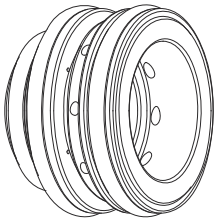
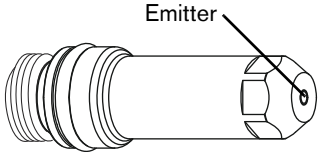


4. Install the nozzle retaining cap onto the torch head



5. Install the shield onto the nozzle retaining cap

Inspect consumables

Inspect	Look for	Action
Shield 	**General:**	
	Erosion or missing material	Replace the shield
	Molten material attached	Replace the shield
	Blocked gas holes	Replace the shield
	Center hole:	
	Must be round	Replace the shield when the center hole is no longer round
Nozzle retaining cap 	**General:**	
	Erosion or missing material	Replace the nozzle retaining cap
	Cracks	Replace the nozzle retaining cap
	Burn marks	Replace the nozzle retaining cap
Nozzle Always replace the nozzle and the electrode as a set 	**General:**	
	Erosion or missing material	Replace the nozzle
	Blocked gas holes	Replace the nozzle
	Center hole:	
	Must be round	Replace the nozzle when the center hole is no longer round
	Signs of arcing	Replace the nozzle
	O-rings:	
	Damage	Replace the o-ring
	Lubricant	Apply a thin film of silicone lubricant if the o-rings are dry
Swirl ring 	**General:**	
	Damage	Replace the swirl ring
	Dirt or debris	Clean and inspect for damage, and replace if damaged
	Blocked gas holes	Replace the swirl ring
	O-rings:	
	Damage	Replace the o-ring
	Lubricant	Apply a thin film of silicone lubricant if the o-rings are dry
Electrode Always replace the nozzle and the electrode as a set 	**Center surface:**	
	Emitter wear – a pit forms as the emitter wears	In general, replace the electrode when the pit depth is 1 mm (0.04 in.) or greater.
	O-rings:	
	Damage	Replace the o-ring
	Lubricant	Apply a thin film of silicone lubricant if the o-rings are dry

Torch maintenance

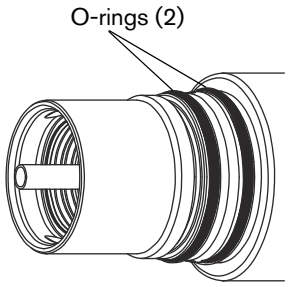
Poor cut quality and premature failure may occur if the torch is not maintained properly.

The torch is manufactured to very tight tolerances to maximize cut quality. The torch should not be subjected to hard impacts that can cause critical features to become misaligned.

The torch should be stored in a clean location when not in use, to avoid contamination of critical surfaces and passages.

Routine maintenance

The following steps should be completed each time consumables are changed:

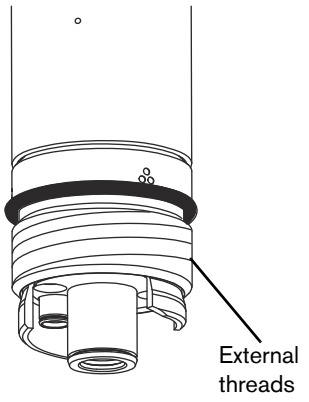


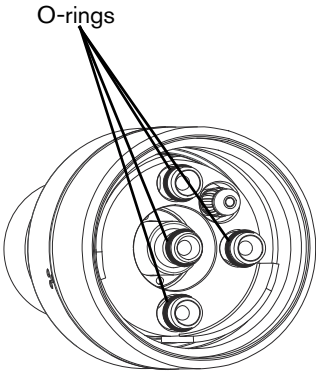
1. Use a clean cloth to wipe off the torch inside and outside. A cotton swab can be used to access hard-to-reach internal surfaces.
2. Use compressed air to blow away any remaining dirt and debris from internal and external surfaces.
3. Apply a thin film of silicone lubricant on each external o-ring. The o-rings should look shiny, but there should not be any excess or built-up lubricant.
4. If consumables will be reused, use a clean cloth to wipe them off, and use compressed air to blow them off before they are installed again. This is especially critical for the nozzle retaining cap.

Quick-disconnect maintenance

The following steps should be completed every 5–10 times consumables are changed:

1. Remove the torch from the quick-disconnect assembly.
2. Use compressed air to blow off all internal surfaces and the external threads.
3. Use compressed air to blow off all internal surfaces at the rear of the torch.
4. Inspect each of the 4 o-rings at the rear of the torch and the o-ring on the quick-disconnect receptacle for damage. Replace any damaged o-rings. If they are not damaged, apply a thin film of silicone lubricant on each o-ring. The o-rings should look shiny, but there should not be any excess or built-up lubricant.





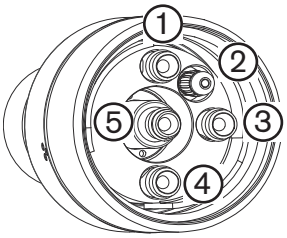
Rear view of torch

Maintenance kit

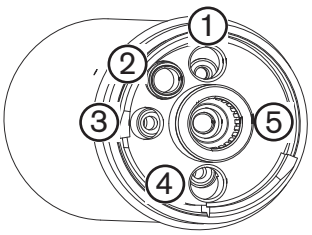
Even with proper care, the o-rings at the rear of the torch will need to be replaced periodically. Hypertherm provides a quick-disconnect torch maintenance kit (228780) with replacement parts. The kit should be kept in stock and be used as part of your routine maintenance schedule. The straight torch and the hand torches only have two replaceable o-rings.

Torch connections

Quick-disconnect torch



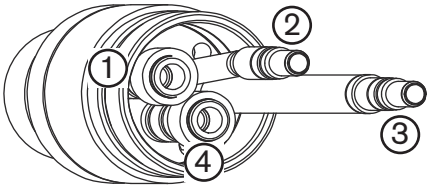
Torch main body



Quick-disconnect receptacle

1	Shield gas
2	Pilot arc
3	Coolant return
4	Plasma gas
5	Coolant supply

Straight torch



1	Plasma gas
2	Coolant supply (also contains the negative lead)
3	Shield gas (also contains the pilot arc lead)
4	Coolant return

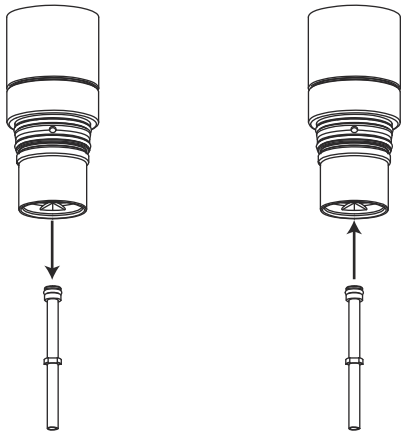
Replace the torch water tube

WARNING!

DO NOT CHANGE CONSUMABLE PARTS WHILE IN THE IDLE MODE. Always disconnect power to the power supply before inspecting or changing torch consumable parts. Use gloves when removing consumables. The torch might be hot.

Note: The water tube may seem loose when correctly inserted, but any side-to-side looseness will disappear after the electrode is installed.

1. Turn OFF all power to the system.
2. Remove consumables from torch. See *Install and inspect consumables on page 90*.
3. Remove the old water tube.
4. Apply a thin film of silicone lubricant on the o-ring, and install a new water tube. The o-ring should look shiny, but there should not be any excess or built-up lubricant.
5. Replace consumables. See *Install and inspect consumables on page 90*.



Common cutting faults

Machine torch

- Torch pilot arc will initiate, but will not transfer. Causes can be:
  - Work cable connection on the cutting table is not making good contact.
  - Malfunction in the system. See the *Troubleshooting table* on page 129 in the *Maintenance* section of this manual.
  - Torch-to-work distance is too high.
- The workpiece is not totally penetrated, and there is excessive sparking on top of the workpiece. Causes can be:
  - Current is set too low (check cut chart information).
  - Cut speed or cut height is too high (check cut chart information).
  - Torch parts are worn or incorrect (see *Install and inspect consumables on page 90)*.
  - Metal being cut is too thick.
- Dross forms on the bottom of the cut. Causes can be:
  - Cutting speed is not correct (check cut chart information).
  - Arc current is set too low (check cut chart information).
  - Torch parts are worn or incorrect (see *Install and inspect consumables on page 90*).
- Cut angle is not square. Causes can be:
  - Wrong direction of machine travel. High-quality side is on the right with respect to the forward motion of the torch.
  - Torch-to-work distance is not correct (check cut chart information).
  - Cutting speed is not correct (check cut chart information).
  - Arc current is not correct (check cut chart information).
  - Damaged or worn consumable parts (see *Install and inspect consumables on page 90*).
- Short consumable life. Causes can be:
  - Arc current, arc voltage, travel speed, motion delay, gas flow rates, or initial torch height not set as specified in the Cut charts.
  - Attempting to cut highly magnetic metal plate, such as armor plate with a high nickel content, will shorten consumable life. Long consumable life is difficult to achieve when cutting plate that is magnetized or becomes magnetized easily.
  - Beginning or ending the cut beyond the plate surface. This draws the arc sideways and can damage the nozzle or shield. To achieve consumable long life, all cuts must begin and end on the plate surface.

Hand torch

- The torch does not cut completely through the workpiece. The causes can be:
  - The cut speed is too fast.
  - The consumables are worn.
  - The metal being cut is too thick for the selected amperage.
  - Gouging consumables are installed instead of drag-cutting consumables.
  - The work clamp is not attached properly to the workpiece.
  - The gas pressure or gas flow rate is too low.

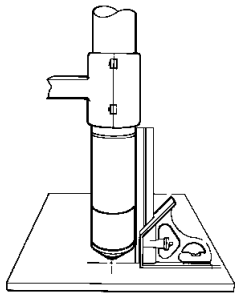
- Cut quality is poor. The causes can be:
  - The metal being cut is too thick for the amperage.
  - The wrong consumables are being used (gouging consumables are installed instead of drag-cutting consumables, for example).
  - Moving the torch too quickly or too slowly.
- The arc sputters and consumables life is shorter than expected. The cause can be:
  - Moisture in the gas supply.
  - Incorrect gas pressure.
  - Consumables incorrectly installed.

Optimizing cut quality

The following tips and procedures will help produce square, straight, smooth, and dross-free cuts.

Tips for table and torch

- Use a square to align the torch at right angles to the workpiece.
- The torch may travel more smoothly if you clean, check, and tune motion on the rails and drive system of the cutting table. Unsteady machine motion can cause a regular, wavy pattern on the cut surface.
- The torch must not touch the workpiece during cutting. Contact can damage the shield and nozzle, and affect the cut surface.



Plasma setup tips

Follow carefully each step in the Daily Start-up procedure described earlier in this section.

Purge the gas lines before cutting.

Maximize the life of consumable parts

Hypertherm's LongLife® process automatically increases the gas and current flow at the start of each cut and decreases them at the end to minimize erosion of the electrode's center surface. The LongLife process also requires that cuts start and stop on the workpiece.

- The torch should never fire into the air.
  - Starting the cut at the edge of the workpiece is acceptable, as long as the arc is not fired in the air.
  - To start with a pierce, use a pierce height that is 1.5 to 2 times the cut height. Refer to the cut chart for your process for more information.
- Each cut should end with the arc still attached to the workpiece to avoid arc blow-outs (ramp-down errors).
  - When cutting small parts that drop down after being cut from the workpiece, check that the arc remains attached to the edge of the workpiece for proper ramp-down.
- If arc blow-outs occur, try one or more of the following:
  - Reduce the cutting speed during the final part of the cut.
  - Stop the arc before the part is completely cut to allow completion of the cut during the ramp-down.
  - Program the path of the torch into the scrap area for ramp-down.

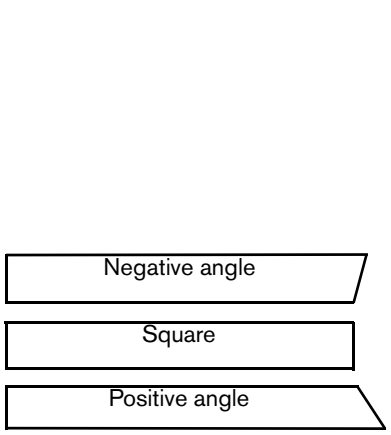
Notes:

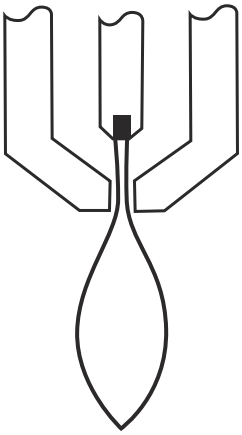
- Program the path of the torch directly from one cut part into the next, without stopping and starting the arc. However, do not allow the path to lead off the workpiece and back on.
- It may be difficult to achieve the full benefits of the LongLife process in some conditions.

Additional factors of cut quality

Cut angle

- A cut part whose 4 sides average less than 4° of cut angle is considered acceptable.
- The squarest cut angle will be on the right side with respect to the forward motion of the torch.
- To determine whether a cut-angle problem is being caused by the plasma system or the drive system:
  a. Make a test cut and measure the angle of each side.
  b. Rotate the torch 90° in its holder and repeat the process.
  c. If the angles are the same in both tests, the problem is in the drive system.
- If a cut-angle problem persists after mechanical causes have been eliminated (see *Tips for table and torch*), check the cut height, especially if cut angles are all positive or all negative.
  - A positive cut angle results when more material is removed from the top of the cut than from the bottom.
  - A negative cut angle results when more material is removed from the bottom of the cut.





Cause	Solution
The torch is too low.	Increase arc voltage to raise the torch
The torch is too high.	Decrease arc voltage to lower the torch.

Dross

Low-speed dross forms when the torch's cutting speed is too slow and the arc shoots ahead. It forms as a heavy, bubbly deposit at the bottom of the cut and can be removed easily. Increase the speed to reduce the dross.

High-speed dross forms when the cutting speed is too fast and the arc lags behind. It forms as a thin, linear bead of solid metal attached very closely to the cut. It is welded to the bottom of the cut and is difficult to remove. To reduce high-speed dross:

- Decrease the cutting speed.
- Decrease arc voltage to decrease the torch-to-work distance.

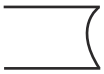
Notes:

- Dross is more likely to form on warm or hot metal than on cool metal. The first cut in a series of cuts will likely produce the least dross. As the workpiece heats up, more dross may form during subsequent cuts.
- Dross is more likely to form on mild steel than on stainless steel or aluminum.
- Worn or damaged consumables may produce intermittent dross.

Straightness of the cut surface

A typical plasma cut surface is slightly concave.

The cut surface may become more concave, or convex. Correct torch height is required to keep the cut surface acceptably close to straight.



A strongly concave cut surface occurs when the torch-to-work distance is too low. Increase the arc voltage to increase the torch-to-work distance and straighten the cut surface.

A convex cut surface occurs when the cut height is too great or the cutting current is too high. First, reduce the arc voltage, then reduce the cutting current. If there is overlap between different cutting currents for that thickness, try the consumables designed for the lower current.

How to increase cutting speed

To increase cutting speed, you can decrease the torch-to-work distance. However, decreasing this distance will increase the negative cut angle.

For mechanized applications the torch must not touch the workpiece while piercing or cutting.

For hand held applications the shield can be touching the workpiece to provide stability during cutting.

Estimated kerf-width compensation

The kerf widths in the following charts are for reference. Differences between installations and material composition may cause actual results to vary from those shown in the tables.

Metric

	Thickness (mm)																				
Mild steel	**0.5**	**0.8**	**1**	**1.2**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**	**8**	**10**	**12**	**15**	**20**	**25**	**32**	**38**	**44**	**50**
50A Air / Air	1.72	1.51	1.46	1.52	1.62	1.58	1.53	1.47	1.44		1.57										
50A O_2 / Air	1.36	1.35	1.36	1.37	1.39	1.41	1.42	1.44	1.51		1.52										
130A Air / Air								2.08	2.21		2.38		2.45	2.48	2.68	3.08	3.46	3.98			
130A O_2 / Air								2.29	2.35		2.40		2.56	2.63	2.92	3.45	3.82	4.33	4.78		
200A Air / Air											2.68	2.90	2.98	2.95	3.12	3.53	3.98	4.20	4.37	5.02	5.69
200A O_2 / Air											2.55	2.95	3.11	3.04	3.13	3.44	3.96	4.60	5.15	5.77	6.40
	Thickness (mm)																				
Stainless steel	**0.5**	**0.8**	**1**	**1.2**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**	**8**	**10**	**12**	**15**	**20**	**25**	**32**	**38**	**44**	**50**
50A Air / Air	1.45	1.71	1.77	1.68	1.56	1.52	1.50	1.55	1.66		1.71										
130A Air / Air											2.57		2.70	2.74	2.90	3.19					
130A N_2 / N_2										2.56	2.40		2.43	2.40	2.59	2.97					
200A Air / Air									3.03		2.76		2.76	2.76	2.98	3.35	3.42	3.64	3.85		4.67
200A N_2 / N_2										3.36	3.20		2.94	2.95	3.32	3.92	3.71	4.22	4.70		
	Thickness (mm)																				
Aluminum	**0.5**	**0.8**	**1**	**1.2**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**	**8**	**10**	**12**	**15**	**20**	**25**	**32**	**38**	**44**	**50**
50A Air / Air	1.40	1.40	1.40	1.40	1.40	1.47	1.50	1.52	1.55		1.58										
130A Air / Air											2.84		2.80	2.78	2.76	2.77	2.88				
130A N_2 / N_2										2.73	2.57		2.62	2.46	2.61	3.00					
200A Air / Air									3.73		3.94		3.44	3.42	3.51	3.73	4.03	4.29	5.38		
200A N_2 / N_2										3.55	3.35		3.04	3.02	3.16	3.52	4.00	4.57	5.04		

English

	Thickness (inches)																							
Mild steel	**0.018**	**0.020**	**0.024**	**0.030**	**0.036**	**0.048**	**0.060**	**0.075**	**0.105**	**0.125**	**0.135**	**3/16**	**1/4**	**5/16**	**3/8**	**1/2**	**5/8**	**3/4**	**7/8**	**1**	**1-1/4**	**1-1/2**	**1-3/4**	**2**
50A Air / Air	0.069		0.065	0.061	0.056	0.060	0.064	0.063	0.059		0.056	0.058	0.063											
50A O_2 / Air	0.054		0.053	0.053	0.053	0.054	0.055	0.055	0.056		0.057	0.063	0.059											
130A Air / Air											0.085	0.090	0.095		0.096	0.098	0.108	0.119		0.137	0.156			
130A O_2 / Air											0.092	0.093	0.095		0.100	0.105	0.119	0.133		0.151	0.170	0.188		
200A Air / Air													0.111	0.114	0.118	0.116	0.126	0.135	0.147	0.158	0.165	0.172	0.200	0.227
200A O_2 / Air													0.109		0.123	0.119	0.125	0.132	0.145	0.157	0.180	0.203	0.229	0.255
Stainless steel	**Thickness (inches)**																							
	.018	**.020**	**.024**	**.030**	**.036**	**.048**	**.060**	**.075**	**.105**	**.125**	**.135**	**3/16**	**1/4**	**5/16**	**3/8**	**1/2**	**5/8**	**3/4**	**7/8**	**1**	**1-1/4**	**1-1/2**	**1-3/4**	**2**
50A Air / Air	0.056		0.061	0.066	0.071	0.066	0.061	0.060	0.059	N/A	0.063	0.068	0.067											
130A Air / Air													0.104		0.106	0.108	0.116	0.124						
130A N_2 / N_2												0.101	0.093		0.096	0.094	0.105	0.116						
200A Air / Air												0.119	0.105		0.109	0.109	0.120	0.131	0.135	0.134	0.143	0.152		0.184
200A N_2 / N_2												0.132	0.124		0.116	0.116	0.136	0.156	0.151	0.145	0.165	0.185		
	Thickness (inches)																							
Aluminum	**.018**	**.020**	**.024**	**.030**	**.036**	**.048**	**.060**	**.075**	**.105**	**.125**	**.135**	**3/16**	**1/4**	**5/16**	**3/8**	**1/2**	**5/8**	**3/4**	**7/8**	**1**	**1-1/4**	**1-1/2**	**1-3/4**	**2**
50A Air / Air	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.061	0.061		0.062	0.062											
130A Air / Air													0.112		0.110	0.109	0.109	0.108		0.114				
130A N_2 / N_2												0.107	0.099		0.105	0.095	0.106	0.117						
200A Air / Air												0.151	0.157		0.136	0.134	0.140	0.145	0.152	0.159	0.167	0.213		
200A N_2 / N_2												0.140	0.130		0.120	0.119	0.127	0.135	0.147	0.159	0.179	0.199		

Cut charts

The following cut charts for the MAXPRO200 show the consumable parts, cutting speeds, and the gas and torch settings required for each process, allowing for differences in the lead length. While you can use these parameters for cutting with both mechanized and handheld torches, the consumable part numbers listed with each cut chart are specific to mechanized torches. Refer to *Hand held cutting and gouging consumable selection on page 87* for the consumables to use for handheld torches for each process.

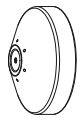
The cut chart values in this document are recommended to provide high quality cuts with minimal dross. Because of differences between installations and material composition, adjustments may be required to obtain desired results.

Mild steel

Air Plasma / Air Shield

50 A Cutting

Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
12/25	103/218



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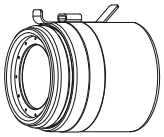

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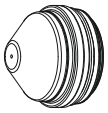

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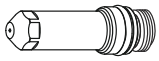


220528

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
62	63	63	63	39	42	45	47	**0.5**	112	1.5	9400	3.0	200	0.0
								0.8	111	1.5	8510	3.0	200	0.0
								1.0	111	1.5	8050	3.0	200	0.1
								1.2	110	1.8	7625	3.6	200	0.1
								1.5	110	1.8	7370	3.6	200	0.1
								2.0	110	1.8	6735	3.6	200	0.1
								2.5	111	2.0	5080	4.0	200	0.2
								3.0	111	2.0	3760	4.0	200	0.3
								4.0	113	2.3	2415	4.6	200	0.4
								6.0	118	2.5	1600	5.0	200	0.5

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
62	63	63	63	39	42	45	47	**0.018**	112	0.06	375	0.12	200	0.0
								0.024	112	0.06	350	0.12	200	0.0
								0.030	111	0.06	340	0.12	200	0.0
								0.036	111	0.06	325	0.12	200	0.1
								0.048	110	0.07	300	0.14	200	0.1
								0.060	110	0.07	290	0.14	200	0.1
								0.075	110	0.07	275	0.14	200	0.1
								0.105	111	0.08	180	0.16	200	0.2
								0.135	111	0.08	110	0.16	200	0.3
								3/16	116	0.09	75	0.18	200	0.4
								1/4	118	0.10	60	0.20	200	0.5

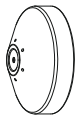
*with IHS tab / **without IHS tab

Mild steel

O_2 Plasma / Air Shield

50 A Cutting

Flow rates – lpm/scfh	
O_2 (Plasma)	Air (Shield)
12/25	73/155



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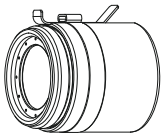

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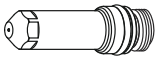
220529



220528

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead length.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
68	68	69	69	25	27	29	31	**0.5**	98	1.5	7550	3.0	200	0.0
								0.8	96	1.5	7050	3.0	200	0.0
								1.0	90	1.5	6775	3.0	200	0.1
								1.2	94	1.5	6600	3.6	200	0.1
								1.5	99	1.5	6150	3.6	200	0.1
								2.0	99	1.5	5400	3.6	200	0.1
								2.5	99	1.8	4300	4.0	200	0.2
								3.0	99	1.8	3650	4.0	200	0.3
								4.0	101	2.0	2800	4.6	200	0.4
								6.0	103	2.5	1750	5.0	200	0.5

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
68	68	69	69	25	27	29	31	**0.018**	98	0.06	300	0.12	200	0.0
								0.024	98	0.06	290	0.12	200	0.0
								0.030	98	0.06	280	0.12	200	0.0
								0.036	89	0.06	270	0.12	200	0.1
								0.048	94	0.06	260	0.12	200	0.1
								0.060	99	0.06	240	0.12	200	0.1
								0.075	99	0.06	220	0.12	200	0.1
								0.105	99	0.07	160	0.14	200	0.2
								0.135	99	0.07	130	0.14	200	0.3
								3/16	103	0.09	85	0.15	150	0.4
								1/4	103	0.10	65	0.15	150	0.5

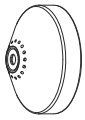
*with IHS tab / **without IHS tab

Mild steel

Air Plasma / Air Shield

130 A Cutting

Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
33/70	68/145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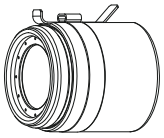
220936* / 220935**

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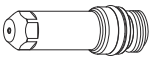

220487

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
68	69	70	71	22	24	26	28	**3.0**	149	3.0	5350	6.0	200	0.1
								4.0	147	3.0	4630	6.0	200	0.2
								6.0	142	2.4	3865	7.2	300	0.3
								10.0	152	4.1	2445	8.2	200	0.5
								12.0	154	4.1	2045	8.2	200	0.5
								15.0	155	4.4	1445	8.8	200	0.8
								20.0	158	4.6	815	9.6	210	1.2
								25.0	166	4.6	415	Edge start		
								32.0	178	5.1	250			

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
68	69	70	71	22	24	26	28	**0.135**	149	0.12	220	0.24	200	0.1
								3/16	145	0.12	160	0.24	200	0.2
								1/4	141	0.10	150	0.28	300	0.3
								3/8	151	0.16	100	0.32	200	0.5
								1/2	154	0.16	75	0.32	200	0.5
								5/8	155	0.18	50	0.36	200	0.8
								3/4	156	0.18	35	0.38	210	1.2
								1	167	0.18	15	Edge start		
								1-1/4	178	0.20	10			

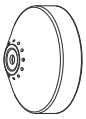
*with IHS tab / **without IHS tab

Mild steel

O_2 Plasma / Air Shield

130 A Cutting

Flow rates – lpm/scfh	
O_2 (Plasma)	Air (Shield)
20/42	86/183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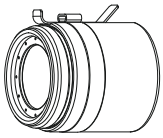
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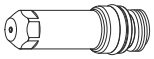
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Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
62	62	64	64	30	32	35	37	**3.0**	130	2.6	5900	5.2	200	0.1
								4.0	131	2.7	5325	5.4	200	0.2
								6.0	134	2.8	3925	5.6	200	0.3
								10.0	136	3.0	2680	6.0	200	0.4
								12.0	138	3.0	2200	6.0	200	0.5
								15.0	140	3.6	1665	7.2	200	0.7
								20.0	145	3.9	1195	7.8	200	1.0
								25.0	151	4.1	685	Edge start		
								32.0	158	4.6	515			
								38.0	163	4.6	310			

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
62	62	64	64	30	32	35	37	**0.135**	130	0.10	240	0.20	200	0.1
								3/16	132	0.11	190	0.22	200	0.2
								1/4	134	0.11	150	0.22	200	0.3
								3/8	136	0.12	110	0.24	200	0.3
								1/2	138	0.12	80	0.24	200	0.5
								5/8	141	0.15	60	0.30	200	0.7
								3/4	144	0.15	50	0.30	200	1.0
								1	151	0.16	25	Edge start		
								1-1/4	158	0.18	20			
								1-1/2	163	0.18	12			

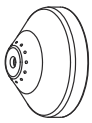
*with IHS tab / **without IHS tab

Mild steel

Air Plasma / Air Shield

200 A Cutting

Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
32/68	123/260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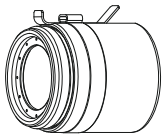
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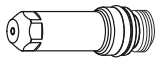
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Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
52	54	55	56	48	50	54	58	**6.0**	147	1.0	4885	3.0	300	0.3
								8.0	148	1.3	4515	3.9	300	0.5
								10.0	151	3.0	3556	5.2	200	0.8
								12.0	153	3.0	2794	6.0	200	0.9
								15.0	158	4.3	2265	8.6	200	1.0
								20.0	165	4.8	1415	9.6	200	1.4
								25.0	172	6.4	940	12.8	200	1.7
								32.0	176	6.4	630	12.8	200	2.3
								38.0	179	6.4	510	Edge start		
								44.0	189	6.4	320			
								50.0	199	6.4	215			

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
52	54	55	56	48	50	54	58	**1/4**	145	0.04	190	0.12	300	0.3
								5/16	148	0.05	180	0.15	300	0.5
								3/8	151	0.10	140	0.20	200	0.8
								1/2	154	0.13	110	0.25	200	0.9
								5/8	159	0.19	85	0.38	200	1.0
								3/4	164	0.19	60	0.38	200	1.2
								7/8	169	0.19	50	0.38	200	1.4
								1	173	0.25	35	0.45	180	1.7
								1-1/4	176	0.25	25	0.45	180	2.3
								1-1/2	179	0.25	20	Edge start		
								1-3/4	190	0.25	12			
								2	200	0.25	8			

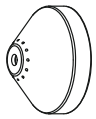
*with IHS tab / **without IHS tab

Mild steel

O_2 Plasma / Air Shield

200 A Cutting

Flow rates – lpm/scfh	
O_2 (Plasma)	Air (Shield)
32/67	123/260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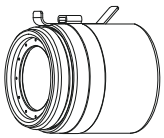
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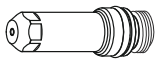
220831

220834


220937

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
68	69	70	71	48	50	54	58	**6.0**	146	1.5	6210	3.0	200	0.3
								8.0	150	3.4	4850	5.1	150	0.4
								10.0	156	4.6	3735	6.9	150	0.4
								12.0	154	3.8	3415	9.5	250	0.6
								15.0	153	3.1	2845	7.8	250	0.7
								20.0	154	3.0	1920	7.5	250	0.8
								25.0	154	3.2	1430	8.0	250	1.0
								32.0	161	3.1	805	7.8	250	1.3
								38.0	168	4.4	570	Edge start		
								44.0	175	4.4	395			
								50.0	180	4.4	270			

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
68	69	70	71	48	50	54	58	**1/4**	143	0.08	235	0.15	200	0.3
								3/8	157	0.19	150	0.28	150	0.3
								1/2	153	0.14	130	0.28	200	0.3
								5/8	153	0.12	105	0.28	250	0.5
								3/4	154	0.12	80	0.28	250	0.6
								7/8	154	0.13	65	0.31	250	0.7
								1	154	0.13	55	0.31	250	0.8
								1-1/4	161	0.13	32	0.35	280	1.5
								1-1/2	168	0.18	22	Edge start		
								1-3/4	175	0.18	15			
								2	181	0.18	10			

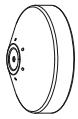
*with IHS tab / **without IHS tab

Stainless steel

Air Plasma / Air Shield

50 A Cutting

Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
12/25	103/218



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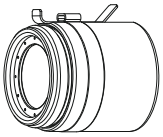
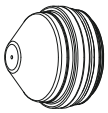


220936* / 220935**



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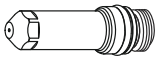
220529



220528

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
62	63	63	63	39	42	45	47	**0.5**	101	1.5	8000	3.0	200	0.0
								0.8	102	1.6	7750	3.2	200	0.0
								1.0	102	1.8	7115	3.6	200	0.1
								1.2	103	1.8	6350	3.6	200	0.1
								1.5	106	1.8	5335	3.6	200	0.1
								2.0	108	2.0	4200	4.0	200	0.1
								2.5	111	2.0	3300	4.0	200	0.2
								3.0	112	2.0	2800	4.0	200	0.3
								4.0	116	2.2	2300	4.4	200	0.4
								6.0	123	2.5	1400	5.0	200	0.5

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
62	63	63	63	39	42	45	47	**0.018**	101	0.06	300	0.12	200	0.0
								0.024	101	0.06	275	0.12	200	0.0
								0.030	102	0.06	265	0.12	200	0.0
								0.036	102	0.06	250	0.12	200	0.1
								0.048	103	0.07	225	0.14	200	0.1
								0.060	106	0.07	190	0.14	200	0.1
								0.075	107	0.07	165	0.14	200	0.1
								0.105	112	0.08	125	0.16	200	0.2
								0.135	113	0.08	85	0.16	200	0.3
								3/16	119	0.09	55	0.18	200	0.4
								1/4	124	0.10	45	0.20	200	0.5

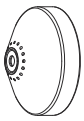
*with IHS tab / **without IHS tab

Stainless steel

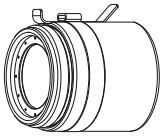
Air Plasma / Air Shield

130 A Cutting

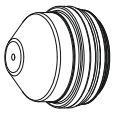
Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
33/70	69/145



220536

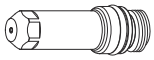


220936* / 220935**



220892

220488



220487

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
68	69	70	71	22	24	26	28	**6.0**	147	3.5	2625	7.0	200	0.3
								10.0	153	4.1	1700	8.2	200	0.5
								12.0	155	4.1	1380	8.2	200	0.8
								15.0	160	4.4	900	Edge start		
								20.0	170	4.6	430			

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
68	69	70	71	22	24	26	28	**1/4**	148	0.14	100	0.28	200	0.3
								3/8	152	0.16	70	0.32	200	0.5
								1/2	156	0.16	50	0.32	200	0.8
								5/8	162	0.18	30	Edge start		
								3/4	168	0.18	20			

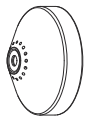
*with IHS tab / **without IHS tab

Stainless steel

N_2 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh	
N_2 (Plasma)	N_2 (Shield)
32/68	104/218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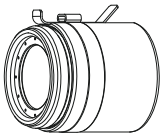
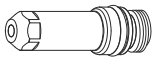

220936* / 220935**

220892

220529


020415

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
68	69	70	71	36	39	42	44	**5.0**	148	3.0	3140	6.1	200	0.3
								6.0	151	3.0	2980	6.1	200	0.3
								10.0	152	3.3	1830	6.6	200	0.5
								12.0	154	3.3	1510	6.6	200	0.8
								15.0	158	3.6	1120	Edge start		
								20.0	166	3.8	470			

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
68	69	70	71	36	39	42	44	**3/16**	149	0.12	125	0.24	200	0.3
								1/4	151	0.12	115	0.24	200	0.3
								3/8	152	0.13	75	0.26	200	0.5
								1/2	154	0.13	55	0.26	200	0.8
								5/8	159	0.14	40	Edge start		
								3/4	165	0.15	25			

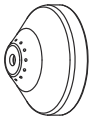
*with IHS tab / **without IHS tab

Stainless steel

Air Plasma / Air Shield

200 A Cutting

Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
32/68	123/260



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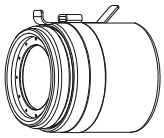
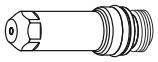


220936* / 220935**

420044

220488



220937

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
52	54	55	56	48	50	54	58	**4.0**	148	2.7	5695	5.4	200	0.4
								6.0	150	3.0	3105	6.0	200	0.4
								10.0	150	3.2	2485	6.4	200	0.5
								12.0	152	3.2	2245	6.4	200	0.8
								15.0	157	3.8	1700	7.6	200	0.8
								20.0	164	4.9	1155	9.8	200	1.0
								25.0	168	5.6	670	11.8	210	1.6
								32.0	174	5.6	515	Edge start		
								38.0	180	5.6	310			
								50.0	188	5.6	203			

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
52	54	55	56	48	50	54	58	**3/16**	149	0.11	240	0.22	200	0.4
								1/4	150	0.12	210	0.24	200	0.4
								3/8	150	0.13	170	0.25	200	0.5
								1/2	153	0.13	120	0.25	200	0.8
								5/8	159	0.16	85	0.32	200	0.8
								3/4	163	0.19	60	0.38	200	1.0
								7/8	166	0.21	50	0.42	200	1.4
								1	168	0.22	40	0.45	210	1.6
								1-1/4	174	0.22	20	Edge start		
								1-1/2	180	0.22	12			
								2	188	0.22	8			

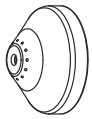
*with IHS tab / **without IHS tab

Stainless steel

N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh	
N_2 (Plasma)	N_2 (Shield)
37/79	107/225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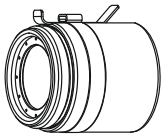
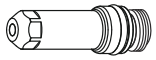

220936* / 220935**

420044

220529


020415

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
69	70	71	72	42	45	48	51	**5.0**	156	3.2	4460	6.4	200	0.4
								6.0	159	3.2	3980	6.4	200	0.4
								10.0	160	3.2	2900	6.4	200	0.5
								12.0	162	3.2	2260	6.4	200	0.8
								15.0	165	3.4	1760	7.9	230	0.9
								20.0	172	4.2	1190	10.1	240	1.1
								25.0	185	6.4	790	11.4	180	2.0
								32.0	191	6.4	520	Edge start		
								38.0	197	6.4	310			

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
69	70	71	72	42	45	48	51	**3/16**	159	0.13	180	0.25	200	0.4
								1/4	159	0.13	150	0.25	200	0.4
								3/8	160	0.13	120	0.25	200	0.5
								1/2	163	0.13	80	0.25	200	0.8
								5/8	166	0.14	65	0.32	230	0.9
								3/4	170	0.16	50	0.38	240	1.0
								7/8	178	0.19	40	0.38	200	1.5
								1	186	0.25	30	0.45	180	2.0
								1-1/4	191	0.25	21	Edge start		
								1-1/2	197	0.25	12			

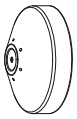
*with IHS tab / **without IHS tab

Aluminum

Air Plasma / Air Shield

50 A Cutting

Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
12/25	104/218



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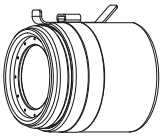
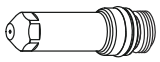


220936* / 220935**

220890

220529



220528

Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
62	63	63	63	39	42	45	47	**0.5**	112	1.5	8000	3.0	200	0.0
								0.8	113	1.6	7750	3.2	200	0.0
								1.0	114	1.8	7115	3.6	200	0.1
								1.2	114	1.8	6350	3.6	200	0.1
								1.5	115	1.8	5335	3.6	200	0.1
								2.0	120	2.0	4200	4.0	200	0.1
								2.5	123	2.0	3300	4.0	200	0.2
								3.0	124	2.0	2800	4.0	200	0.3
								4.0	125	2.2	2300	4.4	200	0.4
								6.0	130	2.5	1400	5.0	200	0.5

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
62	63	63	63	39	42	45	47	**0.018**	112	0.06	325	0.12	200	0.0
								0.020	112	0.06	315	0.12	200	0.0
								0.024	112	0.06	305	0.12	200	0.0
								0.030	113	0.06	295	0.12	200	0.1
								0.036	114	0.07	280	0.14	200	0.1
								0.048	114	0.07	230	0.14	200	0.2
								0.060	115	0.07	195	0.14	200	0.2
								0.075	120	0.08	160	0.16	200	0.2
								0.105	123	0.08	120	0.16	200	0.3
								0.125	124	0.08	100	0.16	200	0.3
								3/16	126	0.09	75	0.18	200	0.4
								1/4	131	0.10	50	0.20	200	0.5

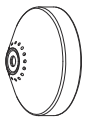
*with IHS tab / **without IHS tab

Aluminum

Air Plasma / Air Shield

130 A Cutting

Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
33/70	69/145



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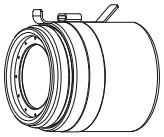

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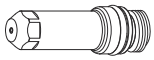

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Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
68	69	70	71	22	24	26	28	**6.0**	156	2.8	2370	5.6	200	0.2
								10.0	161	3.0	1470	6.0	200	0.3
								12.0	163	3.0	1230	6.0	200	0.5
								15.0	165	3.2	1050	6.4	200	0.8
								20.0	169	3.6	725	7.9	220	1.3
								25.0	175	4.0	525	Edge start		

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
68	69	70	71	22	24	26	28	**1/4**	156	0.11	90	0.22	200	0.2
								3/8	160	0.12	60	0.24	200	0.3
								1/2	164	0.12	45	0.24	200	0.5
								5/8	166	0.13	40	0.26	200	0.8
								3/4	168	0.14	30	0.31	220	1.3
								1	176	0.16	20	Edge start		

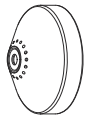
*with IHS tab / **without IHS tab

Aluminum

N_2 Plasma / N_2 Shield

130 A Cutting

Flow rates – lpm/scfh	
N_2 (Plasma)	N_2 (Shield)
32/68	104/218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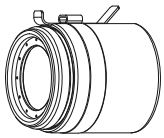
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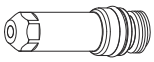
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Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
68	69	70	71	36	39	42	44	**5.0**	153	3.0	3140	6.1	200	0.2
								6.0	154	3.0	2980	6.1	200	0.2
								10.0	158	3.3	1830	6.6	200	0.3
								12.0	160	3.3	1510	6.6	200	0.5
								15.0	162	3.6	1120	7.1	200	0.8
								20.0	166	3.9	470	8.7	220	1.4

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
68	69	70	71	36	39	42	44	**3/16**	153	0.12	125	0.24	200	0.2
								1/4	154	0.12	115	0.24	200	0.2
								3/8	158	0.13	75	0.26	200	0.3
								1/2	160	0.13	55	0.26	200	0.5
								5/8	163	0.14	40	0.28	200	0.8
								3/4	165	0.15	25	0.33	220	1.3

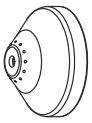
*with IHS tab / **without IHS tab

Aluminum

Air Plasma / Air Shield

200 A Cutting

Flow rates – lpm/scfh	
Air (Plasma)	Air (Shield)
32/68	123/260



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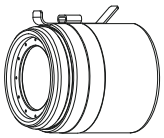

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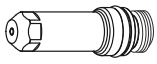

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Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
52	54	55	56	48	50	54	58	**4.0**	150	2.2	6215	4.4	200	0.5
								6.0	156	3.0	5195	6.0	200	0.5
								10.0	156	3.3	3930	6.6	200	0.5
								12.0	159	3.7	3370	7.4	200	0.5
								15.0	163	4.0	2625	8.0	200	0.8
								20.0	169	4.9	1625	9.8	200	1.0
								25.0	177	5.6	1050	11.4	210	1.4
								32.0	187	5.6	515	11.4	210	1.7
								38.0	195	5.6	310	Edge start		

English

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
52	54	55	56	48	50	54	58	**3/16**	150	0.10	230	0.20	200	0.5
								1/4	158	0.13	200	0.25	200	0.5
								3/8	155	0.13	160	0.25	200	0.5
								1/2	160	0.15	125	0.30	200	0.5
								5/8	164	0.16	95	0.32	200	0.8
								3/4	168	0.19	70	0.38	200	1.0
								7/8	173	0.21	50	0.42	200	1.2
								1	178	0.22	40	0.45	210	1.4
								1-1/4	187	0.22	20	0.45	210	1.7
								1-1/2	195	0.22	12	Edge start		

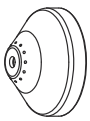
*with IHS tab / **without IHS tab

Aluminum

N_2 Plasma / N_2 Shield

200 A Cutting

Flow rates – lpm/scfh	
N_2 (Plasma)	N_2 (Shield)
37/79	107/225



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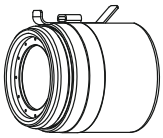

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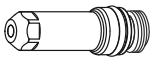

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Note: Gas pressure values are set automatically by the system when the process is chosen. The arc voltage settings in these cut charts were measured with a lead length of 30.5 meters (100 feet). Adjustments to arc voltage settings may be needed for shorter lead lengths.

Metric

Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
7.6 m Lead	15.3 m Lead	22 9 m Lead	30.5 m Lead	7.6 m Lead	15.3 m Lead	22.9 m Lead	30.5 m Lead	**mm**	Volts	mm	mm/min	mm	Factor %	Seconds
69	70	71	72	42	45	48	51	**5.0**	164	3.2	4770	6.4	200	0.5
								6.0	165	3.2	4530	6.4	200	0.5
								10.0	165	3.2	3930	6.4	200	0.5
								12.0	164	3.2	3370	6.4	200	0.5
								15.0	169	4.1	2620	8.1	200	0.8
								20.0	179	5.1	1630	10.2	200	1.2
								25.0	189	6.4	1050	Edge start		
								32.0	198	6.4	500			
								38.0	206	6.4	310			

English

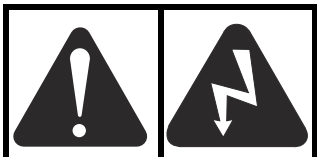
Plasma Cutflow				Shield Cutflow				**Material Thickness**	Arc Voltage	Cut Height	Cutting Speed	Pierce Height		Pierce Delay
25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	25 ft Lead	50 ft Lead	75 ft Lead	100 ft Lead	**in**	Volts	in	ipm	in	Factor %	Seconds
69	70	71	72	42	45	48	51	**3/16**	165	0.13	190	0.25	200	0.5
								1/4	165	0.13	175	0.25	200	0.5
								3/8	165	0.13	160	0.25	200	0.5
								1/2	164	0.13	125	0.25	200	0.5
								5/8	171	0.16	95	0.32	200	0.8
								3/4	177	0.19	70	0.38	200	1.0
								7/8	183	0.25	50	0.45	180	1.5
								1	190	0.25	40	Edge start		
								1-1/4	198	0.25	20			
								1-1/2	206	0.25	12			

*with IHS tab / **without IHS tab

Introduction

Hypertherm assumes that the service personnel performing the troubleshooting testing are high-level electronic service technicians who have worked with high-voltage electro-mechanical systems. Knowledge of final isolation troubleshooting techniques is also assumed.

In addition to being technically qualified, maintenance personnel must perform all testing with safety in mind. Refer to the Safety section for operating precautions and warning formats.



CAUTION!

Use extreme care when working near the chopper modules. Each large electrolytic capacitor (blue-cased cylinder) stores large amounts of electrical energy. Even if the power is off, dangerous voltages may remain at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge any capacitor with a screwdriver or other implement… explosion, property damage and/or personal injury will result.

Preventive maintenance

For a complete list of preventive maintenance recommendations, see the *Preventive Maintenance Master Schedule* on page 159. Contact the Technical Services department listed at the front of this manual with any questions regarding the maintenance schedule or procedures.

Power supply status

The status (state) of the power supply is shown in the three digit display. To view the power supply status, navigate to the fault icon and press and hold the current selection knob until the status code appears.

Status code number	Name
00	Power up
01	Initial checks
02	Gas purge
03	Ready for start
04	Preflow
05	Preflow hold
06	Ignite
07	Pilot arc
08	Rampup
09	Main arc
10	Rampdown
11	Rampdown complete
12	End of cycle
14	Shutdown
17	Standby

Sequence of operation and power supply status

Power up (status 00)

1. Initialization of microprocessor hardware.
2. Initialization of power supply, gas system, and display.
3. System will display dots on the current display.
4. System will look for shield gas button press to indicate USB host firmware update.
5. System will stay in this state until the rocker switch is turned on.

Initial checks (status 01)

1. System will turn on the plasma gas channel at 100% flow and will measure the pressure. The system will use this value as the inlet pressure. If the inlet is above or below the minimum, the system will generate error code 63.
2. System will read the torch ID jumpers, and verify it's a valid ID. If no torch ID is detected the system will generate error code 99.
3. System will perform a chopper test, verifying there is no output.
   a. Main contactor off (open), IGBTs off
      - If there is current on channel A the system will generate error code 401
      - If there is current on channel B the system will generate error code 402
      - If there is current on both channels the system will generate error code 400
   b. Main contactor on (closed), IGBTs off
      - If there is current on channel A the system will generate error code 406
      - If there is current on channel B the system will generate error code 407
      - If there is current on both channels the system will generate error code 408
4. System will verify that there is
   a. No transfer signal or the system will generate error code 108
   b. No start signal or the system will generate error code 50
   c. No coolant flow or the system will generate error code 109
5. System will verify that
   a. Temperatures are above the minimum
      - Chopper temperature is above minimum or the system will generate error code 300
      - Transformer temperature is above minimum or the system will generate error code 301
      - Inductor 1 temperature is above minimum or the system will generate error code 302
      - Inductor 2 temperature is above minimum or the system will generate error code 303
      - Coolant temperature is above minimum or the system will generate error code 304
   b. Temperatures are below the maximum values.
      - Chopper temperature is below maximum or the system will generate error code 65
      - Transformer temperature is below maximum or the system will generate error code 67
      - Inductor 1 temperature is below maximum or the system will generate error code 68
      - Inductor 2 temperature is below maximum or the system will generate error code 69
      - Coolant temperature is below maximum or the system will generate error code 71
6. After about 1 second the system will advance to state 2 (Gas purge) if there are no high priority errors (See *Error codes* on page 127). If a high priority error is generated the system will go to state number 13 (Shutdown).

Gas purge (status 02)

1. System turns on the plasma and shield gases.
2. System counts the time in seconds and this is displayed on the 3-digit current display.
3. System turns on the coolant pump.
4. After six seconds the system will verify the coolant flow is greater than the minimum value.
5. If the coolant flow is above the minimum the system will do a high power test on the chopper.

   Note: the system is "live" at this time. The system is applying power to the torch even though no arc will be present at the torch.
6. Chopper LEM Test
   a. Main contactor closed, IGBTs on
      - If there is no current on channel A the system will generate error code 409
      - If there is no current on channel B the system will generate error code 410
      - If there is no current on both channels the system will generate error code 408

   b. Main contactor closed, IGBTs on
      - If channel A current does not go to 0 the system will generate error code 411
      - If channel B current does not go to 0 the system will generate error code 412
      - If the current on both channels does not go to 0 the system will generate error code 413

   c. Main contactor closed, IGBTs on
      - Channel A current detected on channel B input the system will generate error code 415
      - Channel B current detected on channel A input the system will generate error code 416
      - Channel A current detected on channel B input and Channel B current detected on channel A input the system will generate error code 414

   d. Main contactor closed, IGBTs on
      - Channel A current higher than expected: the system will generate error code 417
      - Channel B current higher than expected: the system will generate error code 418
      - Both channels current higher than expected: the system will generate error code 419
7. If the chopper test is successful and there are no other severe errors the system will advance to state 3 (Ready for start), otherwise the system will go to state 13 (Shutdown).

Ready for start (status 03)

1. System is waiting for a plasma start signal.
2. System is monitoring the over-current signals, and over-temperature conditions.
   - Chopper temperature in range or the system will generate error code 65
   - Transformer temperature in range or the system will generate error code 67
   - Inductor 1 temperature in range or the system will generate error code 68
   - Inductor 2 temperature in range or the system will generate error code 69
   - Coolant temperature in range or the system will generate error code 71
   - Chopper A over-current: the system will generate error code 134
   - Chopper B over-current: the system will generate error code 138
3. System is monitoring the pilot arc duty cycle to ensure it is less than 50%.
4. Diagnostic mode is active, the system will perform the function for the mode that is selected.
   a. Test gas – the plasma and shield gases flow at a set value
   b. Revision – the display will show the software revision

c. Plasma leak check – the plasma channel will be pressurized then the pressure trapped. The display on the power supply control panel will show actual pressures. The system will remain in this state until commanded to another test. The pressure in the plasma channel is expected to remain within 2 psi for a period of 5 minutes. The shield gas channel is expected to drop to near 0 psi.

d. Test gas full pressure – plasma and shield gases flow at full pressure. Low pressure errors will be typical in this mode as the system is attempting to achieve the maximum flow possible.

e. Torch ID – the display on the power supply control panel will show the torch ID

f. In-line valve test – the plasma channel will briefly pressurize, then the system will close the Burkert valve in the power supply and open the in-line torch valve. The plasma pressure is expected to drop to near 0 psi (less than 5 psi), in less than 30 seconds.

5. If a plasma start signal is received and there are no temperature errors, the system will advance to state 4 – Preflow.

Preflow (status 04)

1. System will turn on plasma and shield gases.
2. System will verify gas pressures are above the minimum and below the maximum values.
   - Low plasma pressure: the system will generate error code 44
   - High plasma pressure: the system will generate error code 45
   - Low shield pressure: the system will generate error code 53
   - High shield pressure: the system will generate error code 54
3. System will charge the surge injection circuit.
4. System will check for an over-current condition.
   - Chopper A over-current: the system will generate error code 134
   - Chopper B over-current: the system will generate error code 138
5. After 1 second the system will advance to state 5 (Preflow hold).

Preflow hold (status 05)

1. System will continue running the plasma and shield gas until the hold signal is removed.
2. System will verify the gas pressures are within tolerance.
   - Low plasma pressure: the system will generate error code 44
   - High plasma pressure: the system will generate error code 45
   - Low shield pressure: the system will generate error code 53
   - High shield pressure: the system will generate error code 54
3. System will check for an over-current condition.
   - Chopper A over-current: the system will generate error code 134
   - Chopper B over-current: the system will generate error code 138
4. If the hold signal is active for more than 60 seconds, the system will generate error code 32.
5. When the hold signal is removed the system will advance to state 6 (Ignite).

Ignite (status 06)

1. System will execute the ignition sequence by turning off the torch valve, then turning on the High Frequency. The system will turn on the torch valve again, while continuing to activate the High Frequency.
2. The system will monitor for pilot arc current. If pilot arc current is not detected, the ignition sequence will be repeated up to 5 times, after that the system will have error code 20 (Pilot arc fault) and advance to state 11 (Rampdown Complete).
3. System will check for an over-current condition.
    - Chopper A over-current: the system will generate error code 134
    - Chopper B over-current: the system will generate error code 138
4. If chopper current is detected during the sequence the system will advance to state 7 (Pilot Arc).

Pilot arc (status 07)

1. System will display actual gas pressures on the 2-digit pressure displays.
2. System will verify the gas pressures are within tolerance.
    - Low plasma pressure: the system will generate error code 44
    - High plasma pressure: the system will generate error code 45
    - Low shield pressure: the system will generate error code 53
    - High shield pressure: the system will generate error code 54
3. System will check for over-current.
    - Chopper A over-current: the system will generate error code 134
    - Chopper B over-current: the system will generate error code 138
4. System will check for minimum coolant flow. If it is below minimum the system will generate error code 93.
5. System will check for minimum chopper current. If it is below minimum the system will generate error code 24 (Lost Current Fault).
6. System will check for the arc transfer signal, once it is active the system will advance to state 8, (Rampup).
7. If the transfer signal in not present within 0.5 seconds (Mechanized) or 5.0 seconds (Hand torch) the system will have error code 21 (Transfer fault) and advance to state 11 (Rampdown complete).

Rampup (status 08)

1. System will ramp up the current based on the process parameters.
2. System will verify the gas pressures are within tolerance.
    - Low plasma pressure: the system will generate error code 44
    - High plasma pressure: the system will generate error code 45
    - Low shield pressure: the system will generate error code 53
    - High shield pressure: the system will generate error code 54
3. System will check for over-current.
    - Chopper A over-current: the system will generate error code 134
    - Chopper B over-current: the system will generate error code 138
4. Once the ramp up is finished the system will advance to state 9 (Main arc).

Main arc (status 09)

1. System will display actual current and pressures.
2. System will verify the gas pressures are within tolerance.
    - Low plasma pressure and the system will generate error code 44
    - High plasma pressure and the system will generate error code 45

- Low shield pressure: the system will generate error code 53
- High shield pressure: the system will generate error code 54

3. System will check for over-current.
    - Chopper A over-current: the system will generate error code 134
    - Chopper B over-current: the system will generate error code 138
4. System will check for minimum coolant flow, error code 93.
5. System will check the bus voltage (equivalent to Line voltage).
    - Bus voltage high: the system will generate error code 5
    - Bus voltage low: the system will generate error code 6
6. System will check for phase loss (error code 27).
7. System will check for over-temperature conditions.
    - Chopper overtemperature: the system will generate error code 65
    - Transformer overtemperature: the system will generate error code 67
    - Inductor 1 overtemperature: the system will generate error code 68
    - Inductor 2 overtemperature: the system will generate error code 69
    - Coolant overtemperature: the system will generate error code 71
8. System will check for lost chopper current – error code 24 (Lost Current Fault).
9. System will check for lost transfer – error code 26 (Lost Transfer Fault).
10. If the plasma start signal is removed the system will advance to state 10 (Rampdown).

Rampdown (status 10)

1. System will shut off the plasma and shield gases.
2. System will rampdown the current.
3. When the system reaches the final current, it will advance to state 11 (Rampdown Complete).

Rampdown complete (state 11)

1. Ensure all power supply outputs are off except the main contactor.
2. Advance to state 12 (End of Cycle).

End of cycle (status 12)

1. Turn on plasma and shield gases for postflow.
2. System will verify coolant flow is above the minimum (error code 93).
3. System will verify the plasma start signal is off.
4. Once the plasma start signal is off the system will advance to state 3 (Ready for start).

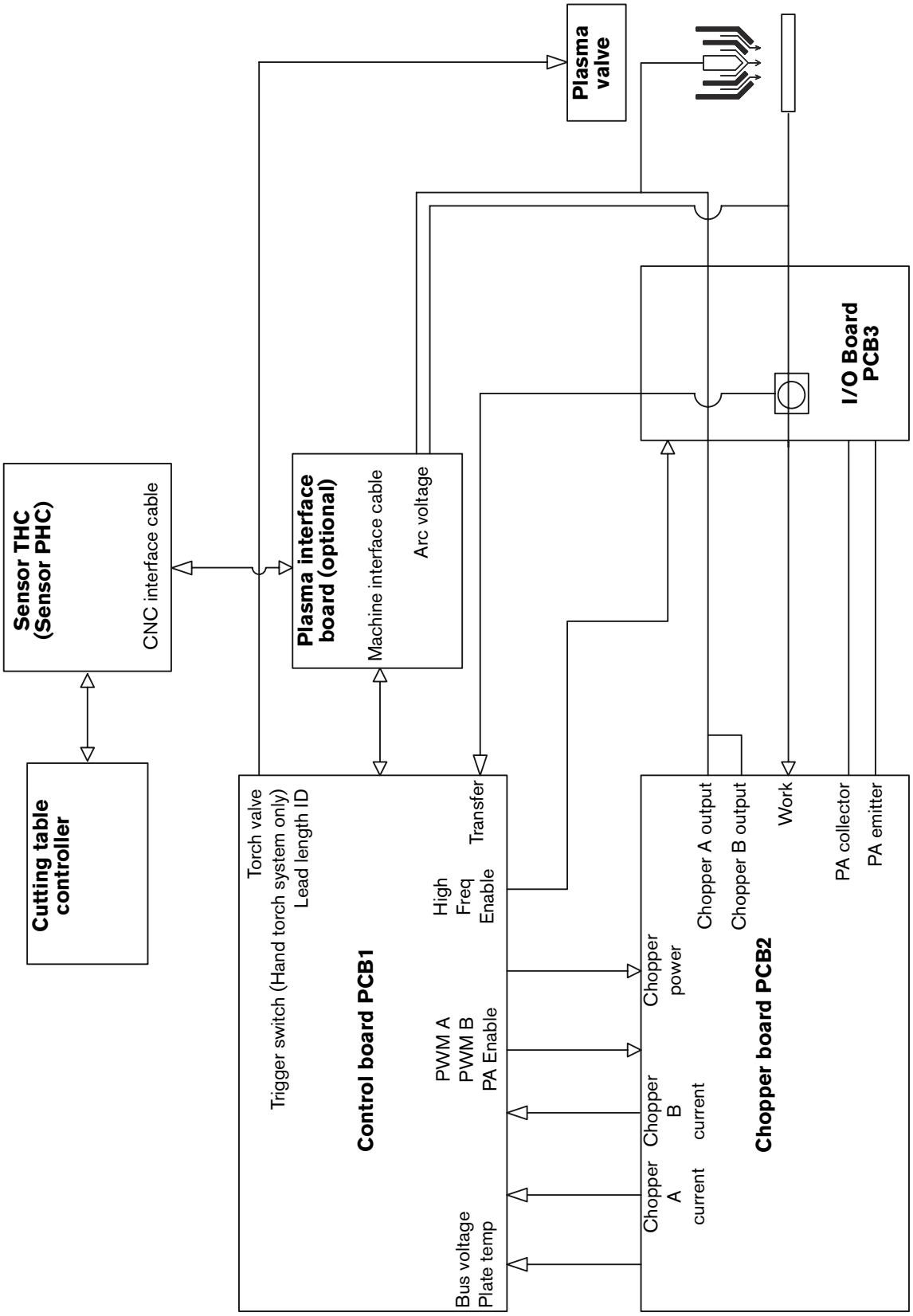
Shutdown (status 14)

1. System will turn off all power supply, coolant, and gas outputs.

Standby (status 17)

1. If the rocker switch is turned off the system will enter the standby state.
2. When the rocker switch is turned on the system will advance to state 0 (Power up).

PCB block diagram



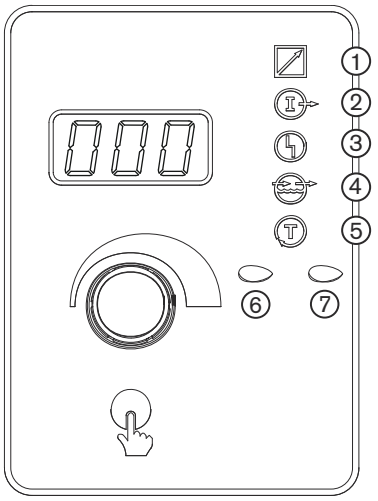
Error codes

When the fault indicator is illuminated the error code number can be seen in the three digit display.

There are three general types of error codes:

- Self clearing – An overtemperature error, for example, will clear when the power supply cools off.
- Low priority – The user must select the *fault* icon and press the current selection knob to see the error code. This type of error can be cleared with the start signal.

High priority – The system will automatically select the *fault* icon and show the error code. This type of error requires the power to the system to be turned off and then on again, after the cause of the error has been corrected.



3-digit display icons	
Name	**Description**
1 Remote	The remote icon illuminates when there is serial communication with the power supply. You can still cycle through the functions but cut parameters can only be changed through the CNC.
2 Amps	Increase or decrease the amperage by selecting the amps icon and turning the knob. The current increases or decreases in 1 amp increments when you turn the knob slowly. You can jump from one process amperage to another when you turn the knob quickly.
3 Fault	The fault icon illuminates when an error occurs. If the error code number is 60 or less, press the current selection knob to navigate to the illuminated fault icon. When the fault icon is selected the error code appears in the 3-digit display. If the error code is 60 or greater the system automatically selects the fault icon and the error code number flashes in the 3-digit display. Press and hold the current selection knob to see the power supply status number for both types of error code.
4 Coolant flow	When the coolant flow icon is selected the display shows the coolant flow in gallons per minute. When you turn ON the power to the system and select the coolant flow icon before the power supply finishes the purge count, the flow switch is overridden and coolant will continue to flow for 30 seconds.
5 Test	When test icon is selected the system is in test mode. A number of functions can be accessed by turning the current selection knob. See the maintenance section for detailed information.
6 Plasma start lamp	This white lamp illuminates when the plasma start signal is given and stays illuminated until the start signal is removed.
7 Arc transfer lamp	This green lamp illuminates when the arc transfers to the workpiece.

Diagnostic functions

Press and release the current selection knob until the Test icon in the 3-digit display is selected. Turn the current selection knob to access the functions shown in the table below. The function activates when the function number appears in the 3-digit display.

Function	Description
000	No function. Gases will stop flowing if the system was in another test mode.
001	Flow gas at set pressure. Plasma and shield gases flow at the set value.
002	Display software revision. Shows the current software revision of the power supply.
003	Plasma gas leak check. The plasma channel is pressurized and the pressure trapped. The 3-digit display shows the actual pressure. The system remains in this state until you select another function or return to cutting. The pressure in the plasma channel should remain stable (+/- 2 psi) for 5 minutes. The shield gas channel should drop to near zero psi (less than 5 psi).
004	Flow gas at full pressure. The plasma and shield gases flow at full pressure. It is typical to see low pressure errors during this function because the system is attempting to achieve the maximum flow possible. Function 4 is used when setting the supply gas regulators.
005	Display torch ID. The torch ID indicates the lead length that is connected to the system.
006	In-line valve check. The plasma channel is pressurize, the system closes the Burkert valve and opens the in-line torch valve. The plasma pressure is expected to drop to near zero psi (less than 5 psi) in less than 30 seconds.

Troubleshooting table

Number	Name	Description	Corrective action
000	No Error	System is ready to run	None
005	Low line voltage	Line voltage is close to or less than the lower limit of 102 VAC (120 VAC -15%). The normal lower limit for operation is 108 VAC (120 VAC -10%).	Verify the line voltage at the control transformer and the fuses on the control board.
006	High line voltage	Line voltage is close to or greater than the upper limit of 138 VAC (120 VAC +15%). The normal upper limit for operation is 132 VAC (120 VAC +10%).	Verify the line voltage at the control transformer and the fuses on the control board.
020	No pilot arc	No current detected from chopper at ignition and before 1-sec timeout	1. Verify that the correct consumable parts are installed and in good condition. 2. Perform the gas checks (See *Control board* on page 144). 3. Verify that there is spark across spark gap. 4. Inspect CON1 for excessive wear. 5. Perform the torch lead test (See *Torch lead test* on page 155). 6. Perform the start circuit test (See *Start circuit troubleshooting* on page 149).
021	No arc transfer	No current detected on work lead 500-msec after pilot arc current was established	1. Verify proper transfer/pierce height. 2. Verify proper cutflow settings. 3. Inspect the work lead for damage or loose connections. 4. Perform the torch lead test (See *Torch lead test* on page 155).
024	Lost current on chopper	Lost current from chopper after transfer	1. Verify that the correct consumable parts are installed and in good condition. 2. Verify proper cutflow gas settings. 3. Verify the pierce height setting. 4. Verify the pierce delay time. 5. Verify that the arc did not lose contact with the plate while cutting (hole cutting, scrap cutting, etc.).
026	Lost transfer	Lost the transfer signal after transfer completed.	1. Verify that the correct consumable parts are installed and in good condition. 2. Verify proper cutflow gas settings. 3. Verify the pierce height setting. 4. Verify pierce delay time. 5. Verify that the arc did not loose contact with the plate while cutting (hole cutting, scrap cutting, etc.). 6. Inspect the work lead for damage or loose connections. 7. Try connecting the work lead directly to the plate.
027	Lost phase	Phase imbalance to chopper after contactor engaged or while cutting	1. Verify phase-to-phase voltage to power supply. 2. Disconnect power to power supply, remove cover on contactor and inspect contacts for excessive wear. 3. Inspect power cord, contactor, and input to chopper for loose connections. 4. Perform phase loss test. See *Phase loss detection* on page 154.

Number	Name	Description	Corrective action
032	Hold timeout	Hold signal was active for longer than 60 seconds	1. Check the interface cable for damage. The hold wires may be short-circuiting inside. 2. The CNC is maintaining this input, it could be waiting for an IHS complete input from another torch. 3. If the CNC interface cable is good and it is a 1-torch system, change the control board.
044	Low plasma gas pressure	Plasma gas pressure is less than 25% of the set (desired) value	1. Inspect gas supply pressure and volume of gas remaining in supply tanks. 2. Verify the gas settings on the front panel with the parameters in the cut charts. 3. See *Setting the supply gas regulators* on page 71. 4. Perform the Flow gas at set pressure test (001), and verify the gas settings on the front panel with the parameters in the cut charts. See *Control board* on page 144.
045	High plasma gas pressure	Plasma gas pressure is greater than 25% of the set (desired) value	1. Verify gas supply pressure settings. 2. Perform the Flow gas at set pressure test (001), and verify the gas settings on the front panel with the parameters in the cut charts. See *Control board* on page 144. 3. See *Setting the supply gas regulators* on page 71. 4. The In-line valve may not be opening. Perform the Plasma leak check (003) and the in-line valve check (006). See *Control board* on page 144.
050	Start lost	Start signal was received and then lost before an arc was established	1. If a mechanical relay is being used to provide the system with a start signal, this relay is either bouncing when activated or the contacts are faulty. Replace the relay. 2. Inspect the interface cable for damage; faulty crimps, or poor electrical connections. 3. If the interface cable is good and a relay is not driving the start input, the CNC is dropping the start signal before a steady state arc has been established. NOTE: It is normal to see an 050 error when cutting with the hand torch if the start signal is removed before the pilot arc time (5 seconds) has expired.
051	Pilot Arc Over-temp	Maximum pilot arc duration exceeded	1. Allow the power supply to idle with the fans running for 10 seconds. 2. Verify that the pierce height is correct. 3. Minimize pilot arcing off the plate.
053	Low shield gas pressure	Shield gas pressure is less than 25% of the set (desired) value	1. Verify gas supply pressure and that sufficient gas remains in your supply. 2. Perform the Flow gas at set pressure test (001), and verify the gas settings on the front panel with the parameters in the cut charts. See *Control board* on page 144. 3. See *Setting the supply gas regulators* on page 71.

Number	Name	Description	Corrective action
054	High shield gas pressure	Shield gas pressure is 25% greater than the set (desired) value	1. Check for a restriction or dross on the shield cap 2. Perform the Flow gas at set pressure test (001), and verify the gas settings on the front panel with the parameters in the cut charts. See *Control board* on page 144. 3. Verify that the pressure transducers are providing the system with the proper pressures.
060	Low coolant flow	Coolant flow is less than the required 2.3 lpm (0.6 gpm)	1. Verify that the correct consumables are properly installed. 2. Perform the coolant flow test procedure. See *Coolant flow test* on page 140.
063	Inlet Pressure Fault	Inlet pressure measured was greater than 135 or less than 40 psi	Verify that the input pressures at the regulators are in range.
065	Chopper over-temp at power-up	Chopper is indicating an over-temp at power-up	1. Verify that the heat exchanger fan is spinning. 2. Blow dust out the heat exchanger with compressed air to clean off the fins. 3. Verify that the level of coolant is at the proper height. 4. Verify that the coolant mixture is correct (% propylene glycol). A mixture with a high percentage of propylene glycol will have a lower cooling capacity. 5. Change the consumables. Older consumables emit more heat into the cooling loop. 6. Verify the pump flow rate. If it is less than 2.3 lpm (0.6 GPM) troubleshoot the low flow rate issue.
067	Magnetics over temp	Main transformer has over heated	1. Verify that the magnetics fan is operating properly. Spinning fan blades should be difficult to see. 2. Blow dust out of the system especially from fans and the main transformer. 3. If voltage is low or near 0 VDC, inspect wiring between the transformer's temperature sensor and J1.12, pins 1 and 2 on the control board. Look for shorts between wires or to ground. 4. If wiring is good, the transformer has overheated. Allow the power supply to idle with the fans running for a minimum of 30 minutes to cool the main transformer.
068	Inductor A over temp	Inductor has over heated	1. Verify that the magnetics fan is operating properly. Spinning fan blades should be difficult to see. 2. Blow dust out of the system especially from fans and inductors. 3. If voltage is low or near 0 VDC, inspect wiring between inductor A's temperature sensor and J1.12, pins 4 and 5 on the control board. Look for shorts between wires or to ground. 4. If wiring is good, the inductor has overheated. Allow the power supply to idle with the fans running for a minimum of 30 minutes to cool the inductors.

Number	Name	Description	Corrective action
069	Inductor B over temp	Inductor has over heated	1. Verify that the magnetics fan is operating properly. Spinning fan blades should be difficult to see. 2. Blow dust out of the system especially from fans and inductors. 3. If voltage is low or near 0 VDC, inspect wiring between inductor B's temperature sensor and J1.12, pins 7 and 8 on the control board. Look for shorts between wires or to ground. 4. If wiring is good, the inductor has overheated. Allow the power supply to idle with the fans running for a minimum of 30 minutes to cool the inductors.
071	Coolant over temp	Torch coolant has overheated	1. Verify that the heat exchanger fan is spinning. 2. Blow dust out the heat exchanger with compressed air to clean off the fins. 3. Verify that the level of coolant is at the proper height. 4. Verify that the coolant mixture is correct (% propylene glycol). A mixture with a high percentage of propylene glycol will have a lower cooling capacity. 5. Change the consumables. Older consumables emit more heat into the cooling loop. 6. Verify the pump Flow rate. If it is less than 0.5 gpm troubleshoot the low flow rate issue. 7. Replace the coolant temperature sensor if it is open or shorted. Replacement part number is 229474.
093	No coolant flow	Coolant flow was below 1.9 lpm (0.5 gpm) while the system was running or the coolant flow was below 1.7 lpm (0.45 gpm) while cutting.	1. Verify that the level of coolant is at the proper level. 2. Verify that the coolant filter is in good condition. replace if necessary. 3. The pump motor may have reached its internal thermal trip point. Make sure the side panel is installed, for proper airflow, and that the heat exchanger fan is working properly. 4. Perform the coolant flow test. See *Coolant flow test* on page 140. 5. See the corrective actions for the low coolant flow error (60).
097	No Torch Found	Torch or torch ID jumper missing or installed incorrectly	1. Verify that the torch connection by the I/O panel (CPC plug) is good. 2. Verify the pin out on the torch lead connection.
102	Current Sensor A Fault	A fault was detected on channel A of the chopper	1. Turn OFF the line power to the system. Check the wiring between the control board and the chopper for damaged wires and proper connections and then turn ON the line power again so the automatic diagnostic checks will run. 2. If the error changes to a 409 error replace the chopper assembly.

Number	Name	Description	Corrective action
108	Transfer at power-up	The system has detected current on the work lead during power-up	1. Verify that the chopper PCB is functioning properly by checking the LEDs on the board against the LED list in the Maintenance section. See *Start circuit troubleshooting* on page 149. 2. Replace the chopper PCB if connections are correct and not damaged. 3. Verify that the main contactor (CON1) is not welded closed, or closing at power-up.
109	Coolant Flow At power-up	Coolant flow measured during power-up and before pump motor has been turned on.	1. Verify that the shield cap is properly installed. A loose shield cap can allow shield gas to get into the coolant, and cause a coolant flow error. 2. Verify that the torch lead connections are good. 3. Turn off the power to the system, wait 30 seconds, and turn the power back on. Sometimes if you turn the power off and then on too quickly it may cause a 109 error. 4. Disconnect the transfer sensor on the I/O board, turn off the power to the system and turn it on again to see if that clears the error.
134	Chopper A over current	Chopper A current exceeded maximum	1. Verify that the chopper PCB is functioning properly by checking the LEDs on the board against the LED list in the Maintenance section. 2. Turn off the power to the system and then turn it on again to verify that the system passes the initial power up test. 3. Verify the current output on J2.1 white to black (4 VDC=100 amps). 4. If the wiring is good, the IGBT may have failed. Replace the chopper assembly.
138	Chopper B over current	Chopper B current has exceeded maximum	1. Verify that the chopper PCB is functioning properly by checking the LEDs on the board against the LED list in the Maintenance section. See *Start circuit troubleshooting* on page 149. 2. Turn off the power to the system and then turn it on again to verify that the system passes the initial power up test. 3. Verify the current output on J2.6 white to black (4 VDC=100 amps). 4. If the wiring is good, the IGBT may have failed. Replace the chopper assembly.
161	High coolant flow rate	Coolant flow rate has exceeded maximum	1. Check to make sure the shield cap is properly installed. A loose shield cap can allow shield gas to get into the coolant, and cause this error. 2. Check to make sure the consumables are installed properly and are not damaged.
190	Current Sensor B Fault	A fault was detected on channel B of the chopper	1. Turn OFF the power to the system. Check the wiring between the control board and the chopper for damaged wires and proper connections and then turn ON the power again so the automatic diagnostic checks will run. 2. If the error changes to a 410 error replace the chopper assembly.

Number	Name	Description	Corrective action
300	Temp sensor unplugged Chopper	The temperature reading was unexpectedly low, possibly indicating the sensor is unplugged	1. Verify that the red and black wires on chopper J2.8 are plugged into the control board at J1.22. 2. Verify the cold plate temperature sensor wires are plugged into the chopper at J2.9 (10K ohm nominal).
301	Temp sensor unplugged Transformer	The temperature reading was unexpectedly low, possibly indicating the sensor is unplugged	Verify the electrical connection back to the control board at J1.12 pins 1-2 (10K ohm nominal).
302	Temp sensor unplugged Inductor 1	The temperature reading was unexpectedly low, possibly indicating the sensor is unplugged	Verify the electrical connection back to the control board at J1.12 pins 4-5 (10K ohm nominal).
303	Temp sensor unplugged Inductor 2	The temperature reading was unexpectedly low, possibly indicating the sensor is unplugged	Verify the electrical connection back to the control board at J1.12 pins 7-8 (10K ohm nominal).
304	Temp sensor unplugged Coolant	The temperature reading was unexpectedly low, possibly indicating the sensor is unplugged	Verify the electrical connection back to the control board at J1.18 pins 6-7 (10K ohm nominal).
400	Current sensor A and Current sensor B current with contactor off	During the chopper test, current was detected on channel A and on channel B when no current was expected	1. Verify that the contactor is not welded shut or always ON. 2. Verify that there is no DC output on the I/O board from the Torch to Work connections. If DC output is found, replace the chopper. 3. Verify that the LED for PWM is not active.
401	Current sensor A current with contactor off	During the chopper test, current was detected on channel A when no current was expected	1. Verify that the contactor is not welded shut or always ON. 2. Verify that there is no DC output on the I/O board from the Torch to Work connections. If DC output is found, replace the chopper. 3. Verify that the LED for PWM is not active.
402	Current sensor B current with contactor off	During the chopper test, current was detected on channel B when no current was expected	1. Verify that the contactor is not welded shut or always ON. 2. Verify that there is no DC output on the I/O board from the Torch to Work connections. If DC output is found, replace the chopper. 3. Verify that the LED for PWM is not active.
405	Current sensor A and Current sensor B current with contactor on and PWM off	During the chopper test, current was detected on channel A and on channel B when no current was expected	1. Verify that the LED for PWM is not active. 2. Verify that there is no DC output on the I/O board from the Torch to Work connections. If DC output is found, replace the chopper.
406	Current sensor A current with contactor on and PWM off	During the chopper test, current was detected on channel A when no current was expected	1. Verify that the LED for PWM is not active. 2. Verify that there is no DC output on the I/O board from the Torch to Work connections. If DC output is found, replace the chopper.
407	Current sensor B current with contactor on and PWM off	During the chopper test, current was detected on channel B when no current was expected	1. Verify that the LED for PWM is not active. 2. Verify that there is no DC output on the I/O board from the Torch to Work connections. If DC output is found, replace the chopper.

Number	Name	Description	Corrective action
408	With choppers active, no current on Current sensor A and Current sensor B during chopper test	No current detected on channel A and channel B when current was expected	1. Verify the output voltage from the contactor. 2. Verify the DC voltage on both bridges of the Chopper. 3. Verify the DC output on the I/O board for each chopper test. 4. Verify that the 10 Ohm resistor on the I/O board is not damaged. 5. Disconnect any exterior equipment from the I/O Board (Example: Arc Voltage connection). 6. Replace the chopper.
409	With choppers active, no current on Current sensor A during chopper test	No current was detected on channel A when current was expected	1. Verify the output voltage from the contactor. 2. Verify the DC voltage on Chopper. 3. Verify the DC output on the I/O board for each chopper test. 4. Verify that the 10 Ohm resistor on the I/O board is not damaged. 5. Disconnect any exterior equipment from the I/O Board (Example: Arc Voltage connection). 6. Replace the chopper.
410	With choppers active, no current on Current sensor B during chopper test	No current was detected on channel B when current was expected	1. Verify the output voltage from the contactor. 2. Verify the DC voltage on Chopper. 3. Verify the DC output on the I/O board for each chopper test. 4. Verify that the 10 Ohm resistor on the I/O board is not damaged. 5. Disconnect any exterior equipment from the I/O Board (Example: Arc Voltage connection). 6. Replace the chopper.
411	Current detected for longer than expected on Current sensor A and Current sensor B	Current on channel A and channel B did not return to 0 as expected	Verify that the surge circuit on the I/O board is functioning properly.
412	Current detected for longer than expected on Current sensor A	Current on channel A did not return to 0 as expected	Verify that the surge circuit on the I/O board is functioning properly.
413	Current detected for longer than expected on Current sensor B	Current on channel B did not return to 0 as expected	Verify that the surge circuit on the I/O board is functioning properly.
414	Current sensor A and Current sensor B signals crossed	Current from output A was detected on channel B and output from channel B was detected on channel A	Verify that the current sensor wiring is not crossed.
415	Current detected on Current sensor B when expected on Current sensor A	Current from output A was detected on channel B	Verify that the current sensor wiring is not crossed.

Number	Name	Description	Corrective action
416	Current detected on Current sensor A when expected on Current sensor B	Current from output B was detected on channel A	Verify that the current sensor wiring is not crossed.
417	Current too high on Current sensor A	Current exceeded the maximum expected value on channel A	1. Verify that the 10 Ohm resistor on the I/O board is not damaged. 2. Disconnect any exterior equipment from the I/O Board (Example: Arc Voltage connection).
418	Current too high on Current sensor B	Current exceeded the maximum expected value on channel B	1. Verify that the 10 Ohm resistor on the I/O board is not damaged. 2. Disconnect any exterior equipment from the I/O Board (Example: Arc Voltage connection).
419	Current too high on Current sensor A and Current sensor B	Current exceeded the maximum expected value on channel A and channel B	1. Verify that the 10 Ohm resistor on the I/O board is not damaged. 2. Disconnect any exterior equipment from the I/O Board (Example: Arc Voltage connection).

Initial checks

Before trouble-shooting, do a visual check and verify that proper voltages are present at the power source, transformers and power distribution board.

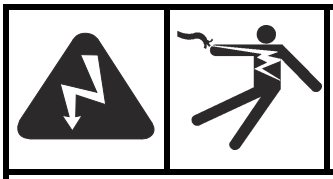
DANGER!

ELECTRIC SHOCK HAZARD

Always use caution when servicing a power supply when plugged in and the covers are removed. Dangerous voltages exist within the power supply which could cause injury or death.

1. Disconnect line power by turning OFF the main disconnect switch.
2. Remove the power supply's top panel and 2 side panels.
3. Inspect interior of power supply for discoloration on PC boards, or other apparent damage. If a component or module is obviously defective, replace it before doing any testing. Refer to the Parts List section to identify parts and part numbers.
4. If no damage is apparent, connect power to the power supply, and turn ON the main disconnect switch.
5. Measure the voltage between the L1, L2 and L3 terminals of TB1 located on the left side of the power supply. See figure on next page. Also refer to the wiring diagram in Section 7, if required. The voltage between any 2 of the 3 terminals should be equal to the supply voltage. If there is a problem at this point, disconnect main power and check all connections, the power cable, and fuses at the line disconnect switch. Repair or replace any defective component.

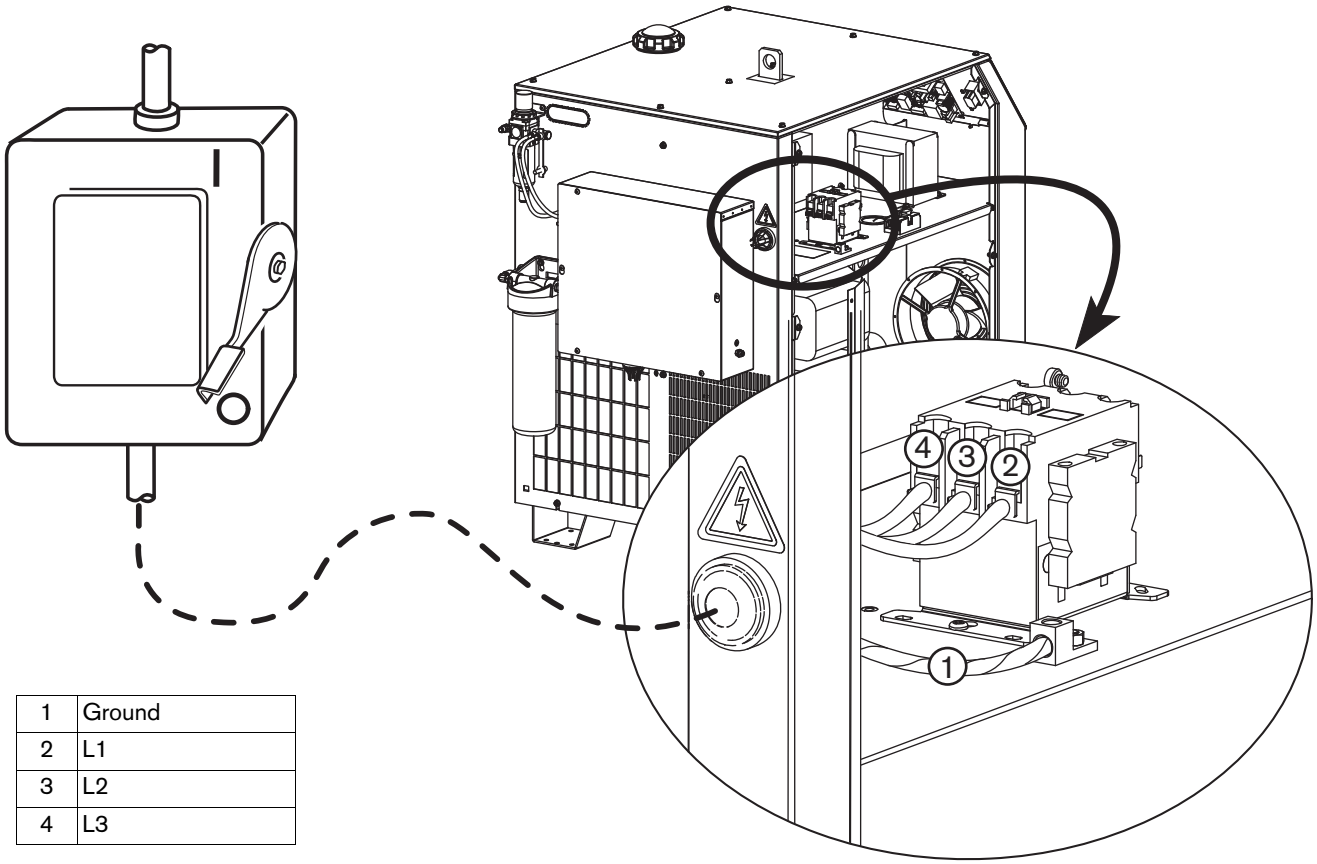
Power measurement



DANGER!

ELECTRIC SHOCK HAZARD

There is line voltage at the contactor when the main disconnect switch is on. Use extreme care when measuring primary power in these areas. Voltages present at the terminal block and contactors can cause injury or death.



1	Ground
2	L1
3	L2
4	L3

Check the lines in the following order:

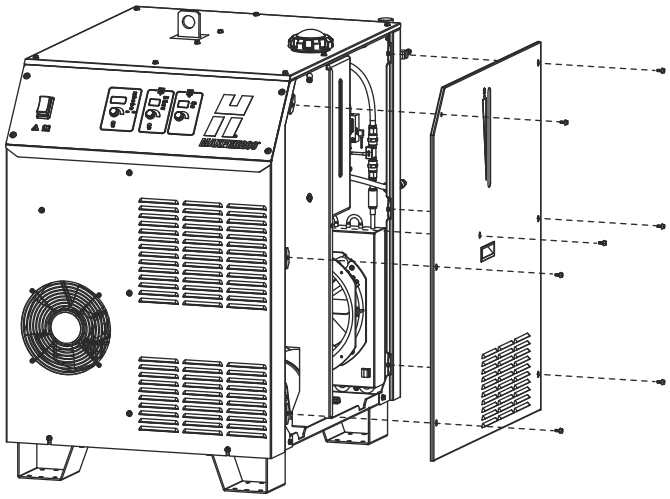
- L1 to L2
- L1 to L3
- L2 to L3

Check each line to ground. If one line is 10% or higher than the other two, put that leg on L1.

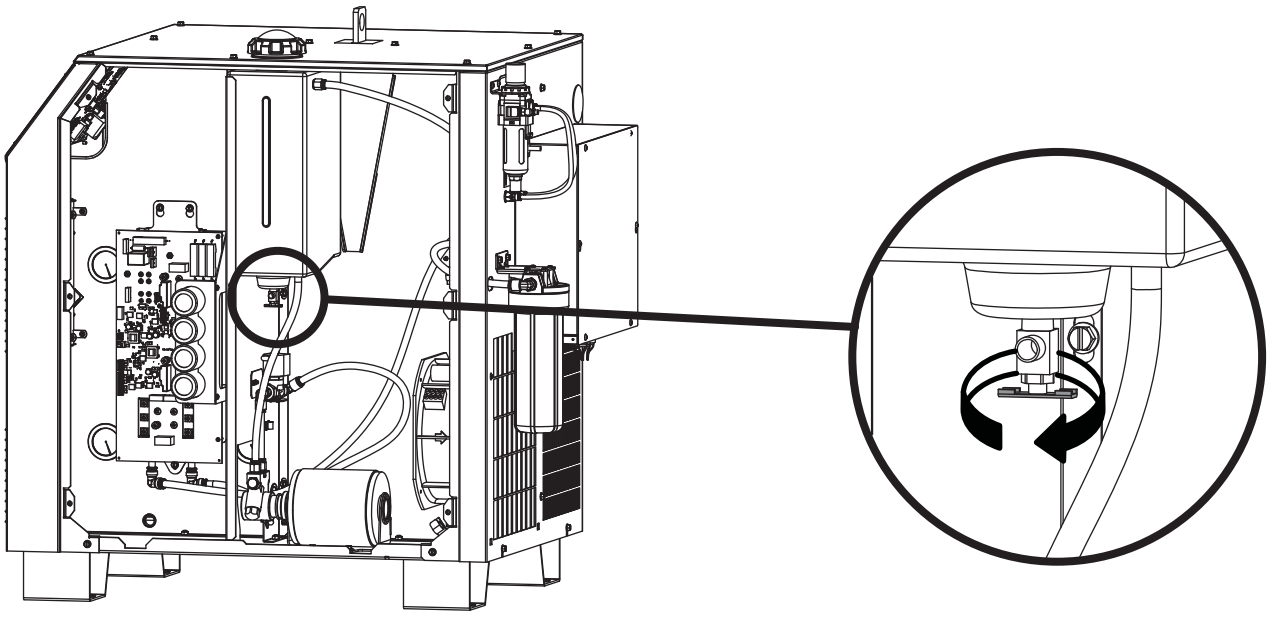
Power supply coolant system servicing

Draining the coolant system

1. Turn OFF the power and remove the right side panel from the power supply.



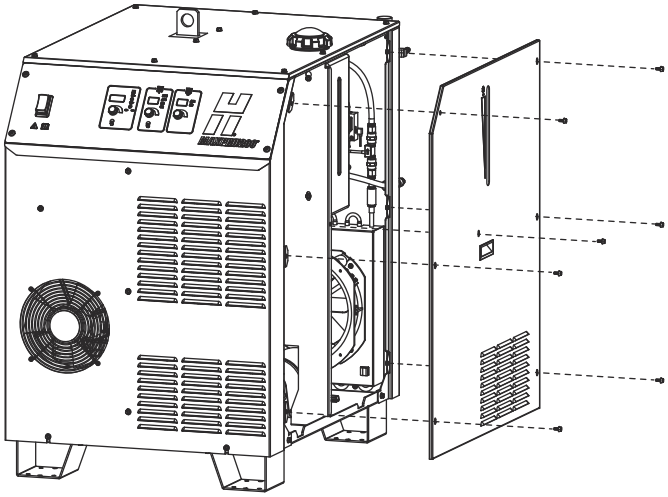
2. Locate the coolant drain valve and use a 20 liter (5 gallon) container to catch the coolant. Coolant will flow as soon as the drain is opened. Close the drain valve when the coolant stops flowing. Always dispose of coolant according to local and national codes.



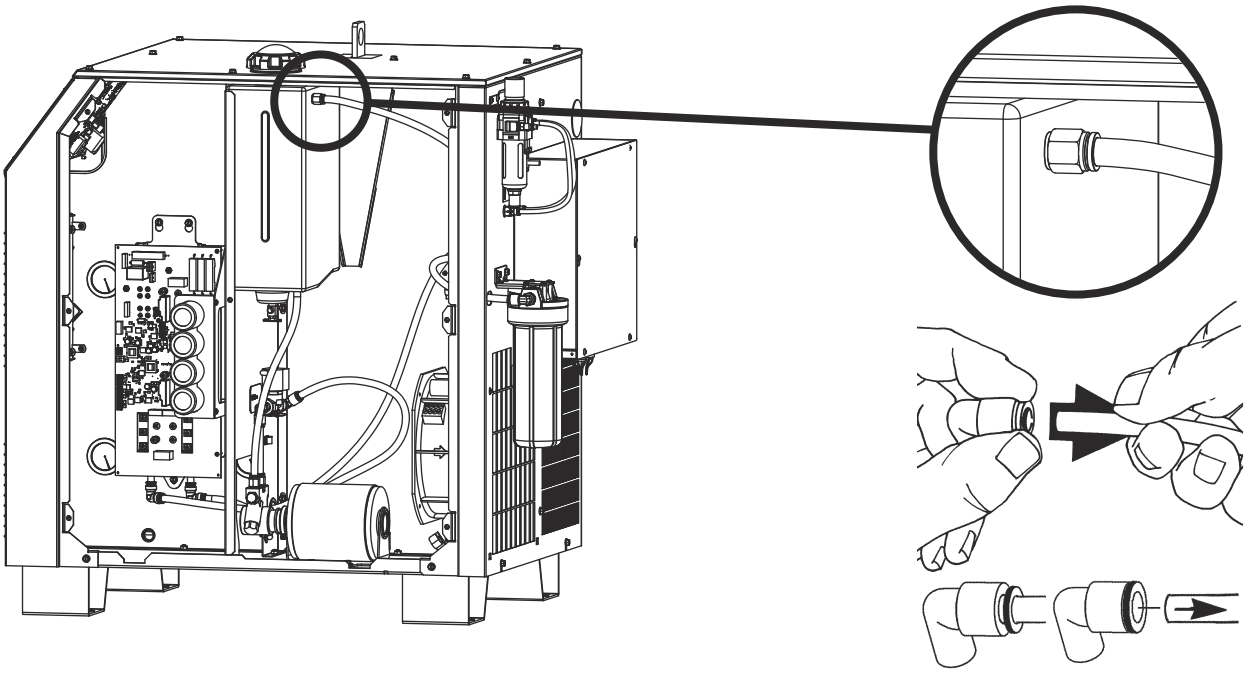
Coolant flow test

The control board receives an electrical signal in Hz from the flow sensor, that is converted and shown as flow in gallons per minute (gpm). Normal flow is 4.5 lpm (1.2 gpm), but this will vary depending on lead lengths and whether the power is 50 Hz or 60 Hz. PCB4 will allow the system to operate if the coolant flow is 1.9 lpm (0.5 gpm) or greater. If the system shows a coolant flow error (093) the system will need to be turned OFF and then ON again and the following test needs to be performed to determine if the problem is coolant flow or the flow switch.

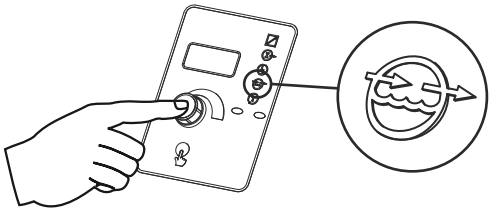
1. Turn OFF the power, and remove the right-side panel from the power supply.



2. Remove the return hose at the top of the coolant tank. Push the connector-collar toward the fitting, and pull the hose away from the fitting This will release the coolant hose. No tools required. Put the end of the return hose into a 4 liter (1 gallon) container.

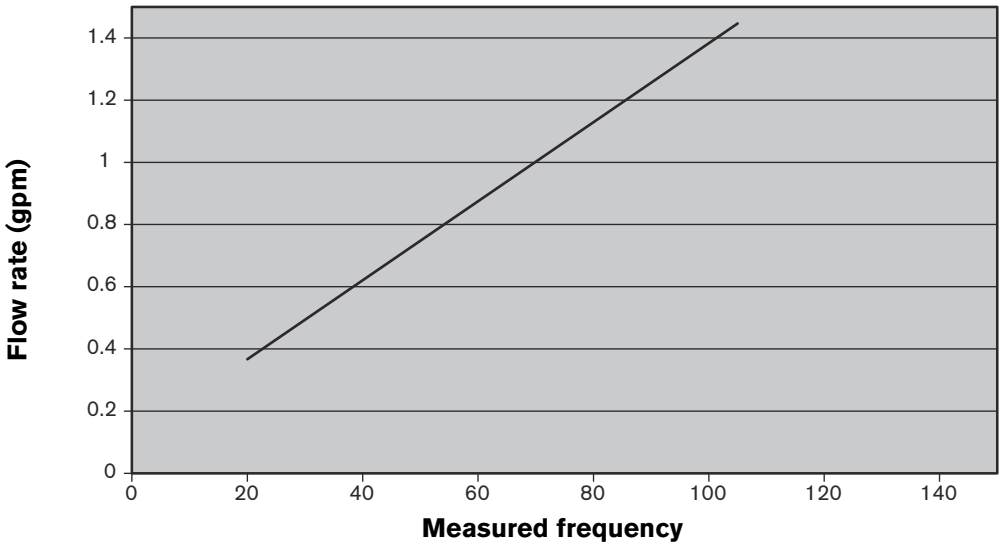


3. You will need to enable the flow function before the count reaches 5 in the 3-digit display. Turn ON the power and press and release the current knob twice until the flow function is enabled. Turn OFF the power after the coolant flows for 30 seconds.



4. Measure the amount of coolant in the container. There should be about 2 liters (0.5 gallon). If there is less than 1 liter (0.25 gallon) there may be a restriction in the coolant system or a problem with the pump or flow sensor.
5. Verify the flow sensor output by measuring the flow output (in frequency) at the control board. Measure the Frequency on J21 pin 3 (pulse) and pin 2 (ground). Once you have the frequency use the chart below to get the flow sensors measured flow rate. If this number differs more than 0.8 lpm (0.2 gpm) from your bucket test, the flow sensor may need to be replaced.

   Note: The 3-digit display shows actual coolant flow. You can compare that measurement to the measurement you get in step 5 to troubleshoot for a PCB problem.



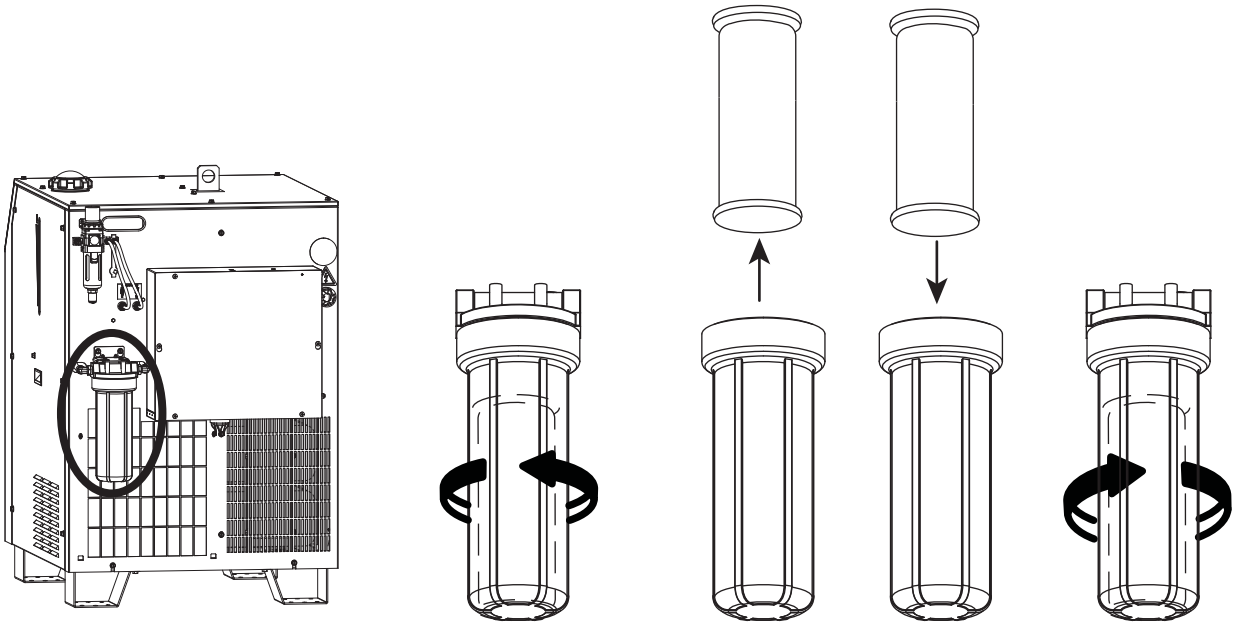
CAUTION!

Coolant will flow from the filter when the housing is removed.

Drain coolant before replacing the filter.

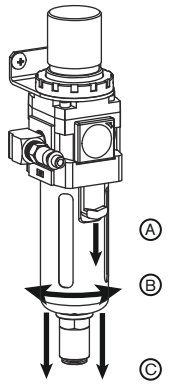
Coolant system filter replacement

1. Make sure the coolant has been drained from the system, then turn OFF all power to the system.
2. Remove the filter housing. Make sure the o-ring inside the filter housing remains in place.
3. Remove and discard the filter element.
4. Install the new filter element 027005.
5. Make sure the o-ring is properly installed before re-installing the housing.
6. Refill the power supply with coolant. See *Fill the power supply with coolant* on page 66.

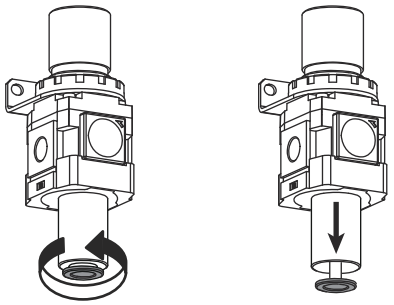


Air filter element replacement

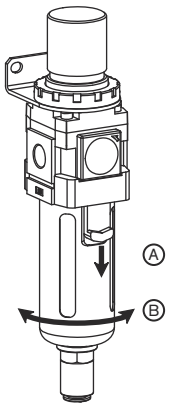
1. Disconnect the electrical power and the gas supply and remove the filter bowl and the old filter element.
   a. Pull down and hold the black release tab.
   b. Rotate the filter bowl in either direction until it releases.
   c. Pull the filter bowl down to remove it. The bowl has an o-ring around the top. Do not discard the o-ring. If the o-ring needs to be replaced, use part number 011105.



2. Turn the plastic disk under the filter element counter-clockwise about 1/4 turn and remove the old filter element. Install the new filter element 011093.



3. Re-install the filter bowl.
   a. Hold down the black tab and slide the filter bowl over the new filter element.
   b. Rotate the filter bowl until it locks in place.



Control board

Control board LED list

LED	Description	LED	Description
D1	Torch ID 0	D46	High frequency ignition (ON = HF circuit active)
D2	Torch ID 1	D51	Contactor output (ON = contacts closed)
D3	Torch ID 2	D61	Torch valve driver error (ON = error)
D4	Torch ID 3	D62	Torch valve driver OK (ON = 24V power is OK)
D6	CNC start signal (ON = active)	D64	Not used
D9	Hold input (ON = active)	D65	Transfer detect (ON = 3.5A or more detected on the work lead)
D12	Motion output	D68	Coolant flow input (pulses from flow sensor)
D14	Error output	D70	Pump enable (ON = pump motor active)
D15	Hold output	D71	Serial communications TX
D16	CAN RX	D96	USB BUS voltage error flag
D17	CAN TX	D100	Over current on chopper B (ON = overcurrent)
D26	+15/-15V voltage indicator	D101	Chopper A PWM
D31	Fused side of 240VAC input power	D102	Chopper B PWM
D33	+3.3V voltage indicator	D103	Pilot arc enable
D35	Overcurrent on chopper A (ON = overcurrent)	D104	Plasma valve PWM
D37	+5V voltage indicator	D105	Shield valve PWM
D40	+24V voltage indicator	D106	Torch valve enable
D41	Fused side of 120VAC input power	D107	Not used
D42	240V input detection (ON = 240VAC input detected)	D111	Serial communications RX
D44	120V input detection (ON = 120VAC input detected)		

Control board test points

Test point	Description	Test point	Description
TP1	+15V	TP18	+5V regulated
TP2	Analog 3.3V	TP19	+5V unregulated (should be 7V or higher)
TP3	Signal ground	TP20	+24V
TP4	+3.3V	TP21	Not used
TP5	-15V	TP22	Serial communications RX
TP6	PWM channel A (5V)	TP23	CNC start +
TP7	PWM channel B (5V)	TP24	CNC start -
TP8	Pilot arc enable (5V)	TP25	Serial communications TX
TP9	Shield valve output (24V)	TP26	15VAC power output to chopper
TP10	Plasma valve enable (5V)	TP27	Inductor 2 temp input (analog 3.3V)
TP11	Shield valve enable (5V)	TP28	Inductor 1 temp input (analog 3.3V)
TP12	Plasma valve output (24V)	TP29	Main transformer temp input (analog 3.3V)
TP13	Plasma valve enable	TP30	Multiplexed transformer and inductor temps input
TP14	Digital logic ground	TP31	+24V (same connection as TP20)
TP15	Power ground	TP32	Spare input not used (analog 3.3V)
TP16	Analog/signal ground	TP33	Plasma pressure input (analog 5V)
TP17	Pump motor enable (5V)	TP34	Shield pressure input (analog 5V)

Hypertherm
141169 REV C

PART NUMBER
SERIAL NUMBER
CM LABEL
TESTED LABEL

J19 61F
J3 EF
D96
BAT1 1AB
J13 SHIELD 1F
J11 PLASMA 1F
J18 1F
J15 1F
J12 1F
J7 1F
J5 5F
J4
D71
D111
J1
U3 FIRMWARE LABEL
U56 FIRMWARE LABEL
J20
D31 240VAC IN
D41 120VAC IN
J9 1F
J8 1F
D40 +24V
D70
TP17 PUMP
240VAC OUT D42
D33 +3.3V
TP19 +5VUN
D51 CNTDR
D46 HF
TP4 +3.3V
120VAC OUT D44
D37 +5V
D35 OCA
D100 OCB
TP18 +5V
TP20 +24V
J14 1F
TP5 -15V
D26 +/-15V
TP1 +15V
D65 D68
TP3
TP24 TP25 15VAC
J22 1F
J16 9I
J21 12F
TP9 SHVLV
TP12 PLVLV
TP16
TP14
TP30
TP27 TP28 TP29 TP32
TP2 A3.3V
CANTX D17 D16 CANRX
TP25 TX RX
TP22
D14 ERR
D9 IGTH
PWRGND TP15
TP31 +24V
D6 START
D1 TID0
D2 TID1
D3 TID2
D4 TID3
D61 FLAG
TP23 TP24
J6 9F
J2 2F
D62 PGOK
D64 OKFLG
J17 41F
TP13 -TCHVLV
TP21 +TCHVLV
TP11 SH
TP10 PL
TP8 PA
TP7 PWMB
TP6 PWMA
D106 D107 D105 D104 D102 D103 D101
D111
D6
D9
D14
D26
D31
D33
D37
D40
D41
D42
D44
D46
D51
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D68
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TP29
TP30
TP31
TP32

Gas leak tests

Note: See *Diagnostic functions* on page 128 for details about getting to the gas test functions.

Function	Description
001	Flow gas at set pressure. Plasma and shield gases flow at the set value.
003	Plasma gas leak check. The plasma channel is pressurized and the pressure trapped. The 3-digit display shows the actual pressure. The system remains in this state until you select another function or return to cutting. The pressure in the plasma channel should remain stable (+/- 2 psi) for 5 minutes. The shield gas channel should drop to near zero psi (less than 5 psi).
004	Flow gas at full pressure. The plasma and shield gases flow at full pressure. It is typical to see low pressure errors during this function because the system is attempting to achieve the maximum flow possible. Function 4 is used when setting the supply gas regulators.
006	In-line valve check. The plasma channel is pressurized, the system closes the Burkert valve and opens the in-line torch valve. The plasma pressure is expected to drop to near zero psi (less than 5 psi) in less than 30 seconds.

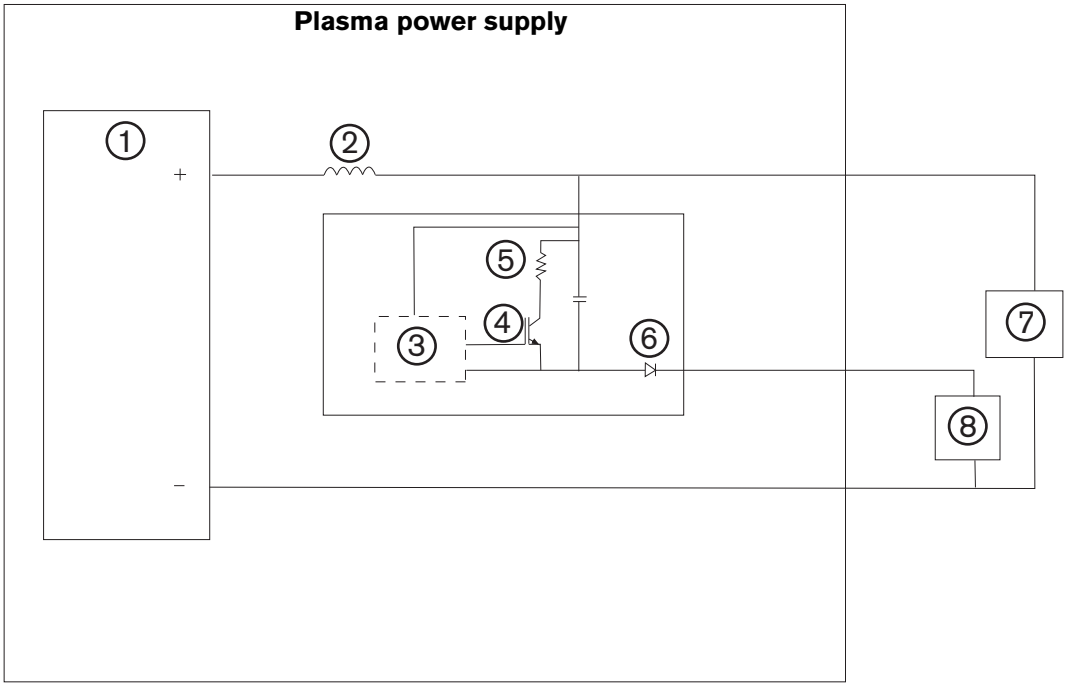
Start circuit

Operation

The start circuit is a high-speed switch that quickly transfers the pilot arc current from the pilot arc lead to the work lead. the start circuit is built into the chopper in the MAXPRO200. The start circuit performs 2 functions:

1. It allows the initial pilot arc current to flow through the pilot arc lead quickly, with little impedance.
2. After initial pilot arc current is established, the start circuit introduces impedance to the pilot arc lead to aid in transferring the arc to the workpiece. See schematic below.

Start circuit functional schematic



Number	Description
1	Chopper
2	Choke
3	Power supply control board
4	IGBT
5	Power resistors
6	Diode
7	Cutting arc
8	Pilot arc

Start circuit troubleshooting

DANGER!

ELECTRIC SHOCK CAN KILL

Before operating this system, you must read the *safety* section thoroughly. Turn OFF the power supply's main disconnect switch before proceeding with the following steps.

D14 should always be illuminated.

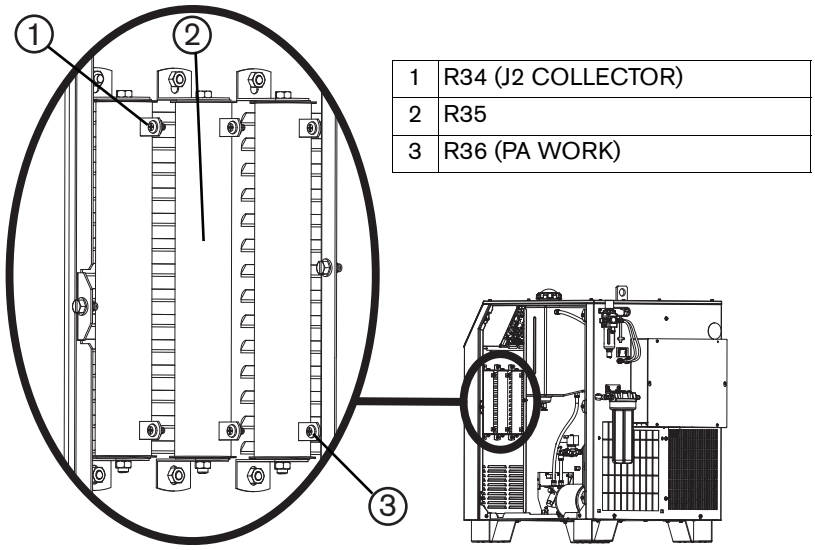
Note: Reference the chopper PCB figure on the next page.

D3 illuminates as soon as the torch fires and will extinguish as soon as the arc transfers to the workpiece. If arc transfer is immediate, the LED may not illuminate.

If there is no arc at the torch or if the arc will not transfer:

1. Turn OFF all power to the system.
2. Remove the 6 AWG wire labeled R36 from the R36 power resistor terminal (PA WORK). Not the smaller 140 mm (5.5 inch) 10 AWG wire that connects to R34.
3. Verify a series resistance of 3 Ω between J2 (COLLECTOR, wire labeled J2.2) and R36 (PA WORK). If the resistance value is not correct, check the wiring connections between J2 (COLLECTOR, wire labeled J2.2) and R34, between R34 (no label on wire) and R35, and between R35 (no label on wire) and R36.

   Note: Resistance value may slowly increase to the correct value due to the capacitance in the circuit.



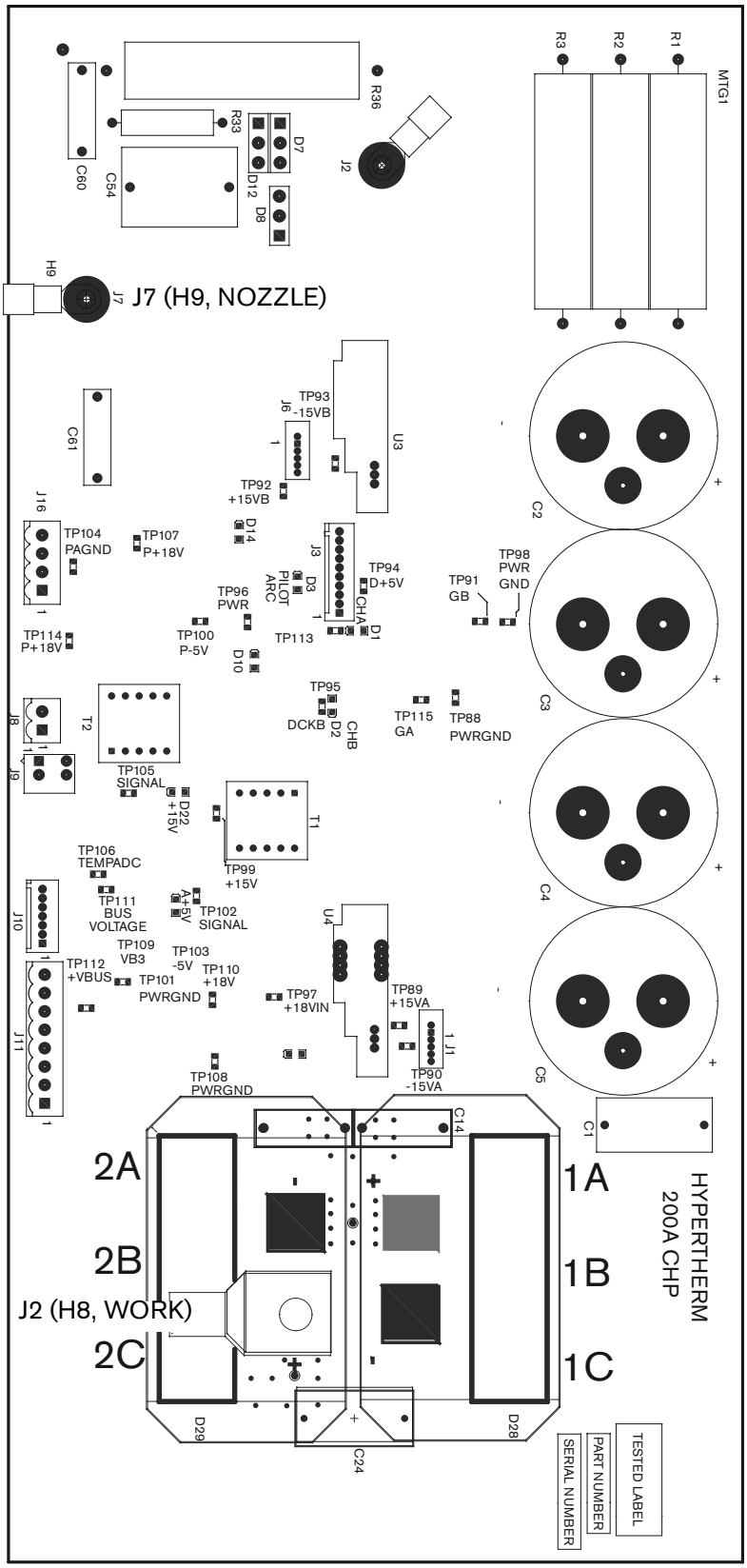
1	R34 (J2 COLLECTOR)
2	R35
3	R36 (PA WORK)

4. Verify a resistance of 1 Ω across each of R34, R35, and R36.
   - The work lead should not have any cuts or breaks. Verify a resistance of 1Ω or less. The work lead connection to the cutting table should be clean and have good contact to the table.
   - Verify that D14 is illuminated. If it is not illuminated the board may need to be replaced or the board may not be receiving power.
   - Fire the torch in the air and verify that D3 is illuminated. If it is not illuminated, but a pilot arc is established, the pilot arc IGBT (Q7) may need to be replaced.
5. Place a 10 AWG (6 mm^2) jumper in parallel across the work lead (WORK, H8, wire labeled J2.9) and J7 (Nozzle, H9, wire labeled J2.7). Perform a test cut. The nozzle will wear out after just a few starts. If the arc transfers, check, R34, R35, R36, Q7, the chopper, and the wiring between them. replace parts as necessary.

Chopper PCB

LED	Description
D1	Chopper A PWM
D2	Chopper B PWM
D3	Pilot arc enable
D6	+18V/-5V chopper circuit power indicator
D10	Gate drive optocoupler +5V power indicator
D14	Pilot arc circuit power indicator
D20	Bus voltage +5V circuit power indicator
D22	Chopper +15V power indicator

Test point	Description
TP88	Chopper ground
TP89	+15V (chopper A)
TP90	-15V (chopper A)
TP91	IGBT chopper B gate drive
TP92	+15V (chopper B)
TP93	-15V (chopper B)
TP94	Gate drive optocoupler +5V
TP95	Chopper B PWM
TP96	Pilot arc circuit ground
TP97	Chopper unregulated +18V (should be +18.5 or higher)
TP98	Chopper ground
TP99	Chopper +15V
TP101	Chopper ground
TP102	Signal (Bus voltage) ground
TP103	Chopper -5V
TP104	Pilot arc ground
TP105	Signal (chopper temp) ground
TP106	Chopper temp (0–5V analog)
TP107	Pilot arc +18V
TP108	Non-isolated chopper ground
TP109	Non-isolated Bus voltage (0–5V analog)
TP110	Chopper +18V
TP111	Isolated Bus voltage (0–5V analog)
TP112	Bus voltage +5V
TP113	Chopper A PWM
TP114	Pilot arc unregulated +18V (should be +18.5 or higher)
TP115	IGBT chopper A gate drive



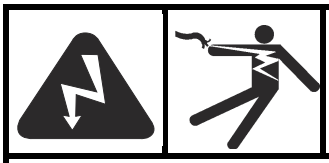
Pilot arc current levels

Plasma gas	50 Amps	130 Amps	200 Amps
Air	20 Amps	35 Amps	40 Amps
N_2	—	35 Amps	40 Amps
O_2	20 Amps	35 Amps	40 Amps

Transfer current

Transfer is determined by CS1 on PCB3 (I/O board). Transfer occurs when the current on the work lead is > 7 Amps.

Chopper tests



WARNING!

ELECTRIC SHOCK HAZARD

Use extreme care when working near the chopper modules. Each large electrolytic capacitor (blue-cased cylinder) stores large amounts of energy in the form of electric voltage. Even if the power is off, dangerous voltages exist at the capacitor terminals, on the chopper, and the diode heatsinks. Never discharge any capacitor with a screwdriver or other implement… explosion, property damage and/or personal injury will result.

Automatic chopper and current sensor tests during power-up

After you turn ON the power to the system and the preflow starts, the system will automatically run the following series of tests:

The system performs a chopper test verifying there is no output current. Less than 5 amps is considered “no current”.

1. The main contactor is open, IGBTs are off
   a. If there is current on channel A, error code 401 is displayed
   b. If there is current on channel B, error code 402 is displayed
   c. If there is current on both channels, error code 400 is displayed
2. The main contactor is closed, IGBTs are off
   a. If there is current on channel A, error code 406 is displayed
   b. If there is current on channel B, error code 407 is displayed
   c. If there is current on both channels, error code 408 is displayed

If the coolant flow is above the minimum level the system will do a high power test on the chopper.

Note: the system is “live” at this time. The system is applying power to the torch even though no arc will be present at the torch.

The system performs a chopper LEM Test. The test checks for current between 10–60 amps. Less than 5 amps is considered “no current”.

3. The main contactor is closed, IGBTs are on
   a. If there is no current on channel A, error code 409 is displayed
   b. If there is no current on channel B, error code 410 is displayed
   c. If there is no current on both channels, error code 408 is displayed
4. The main contactor is closed, IGBTs are on
   a. If channel A current does not go to 0, error code 411 is displayed
   b. If channel B current does not go to 0, error code 412 is displayed
   c. If the current on both channels does not go to 0, error code 413 is displayed
5. The main contactor is closed, IGBTs are on
   a. Channel A current detected on channel B input, error code 415 is displayed
   b. Channel B current detected on channel A input, error code 416 is displayed
   c. Channel A current detected on channel B input and Channel B current detected on channel A input, error code 414 is displayed

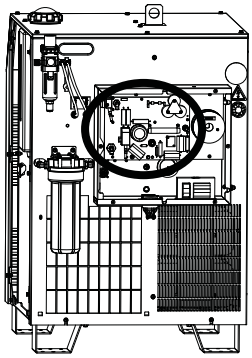
6. The main contactor is closed, IGBTs are on
   a. Channel A current higher than expected, error code 417 is displayed
   b. Channel B current higher than expected, error code 418 is displayed
   c. Current on both channels is higher than expected, error code 419 is displayed

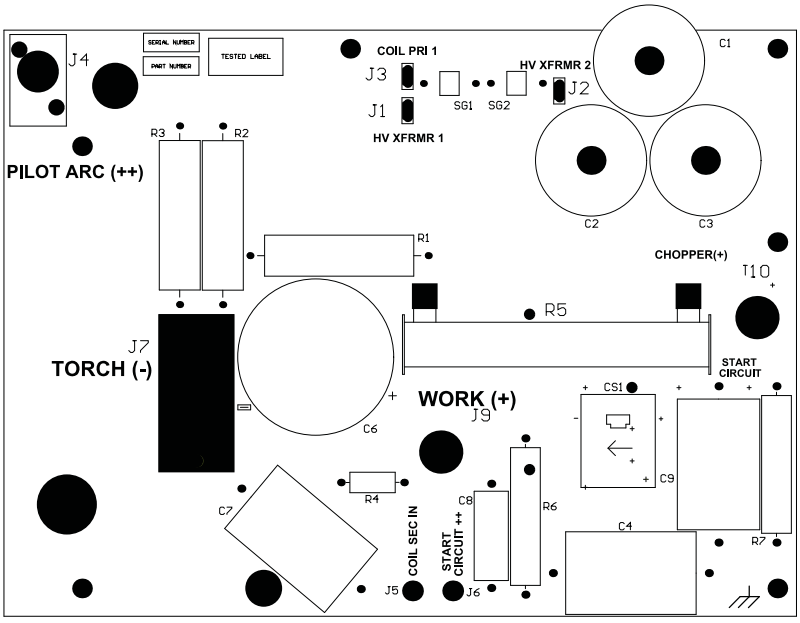
If the chopper test is successful and there are no other severe errors the system will advance to state #3, “Ready for start”, otherwise the system will go to state #14 “Shutdown”.

Using a meter to measure open circuit voltage (OCV)

The OCV is 360VDC with no load on the system and can only be measured when the contactor is closed. The VAC on the chopper bridges are 127 VAC on 1A-1B-1C & 2A-2B-2C.

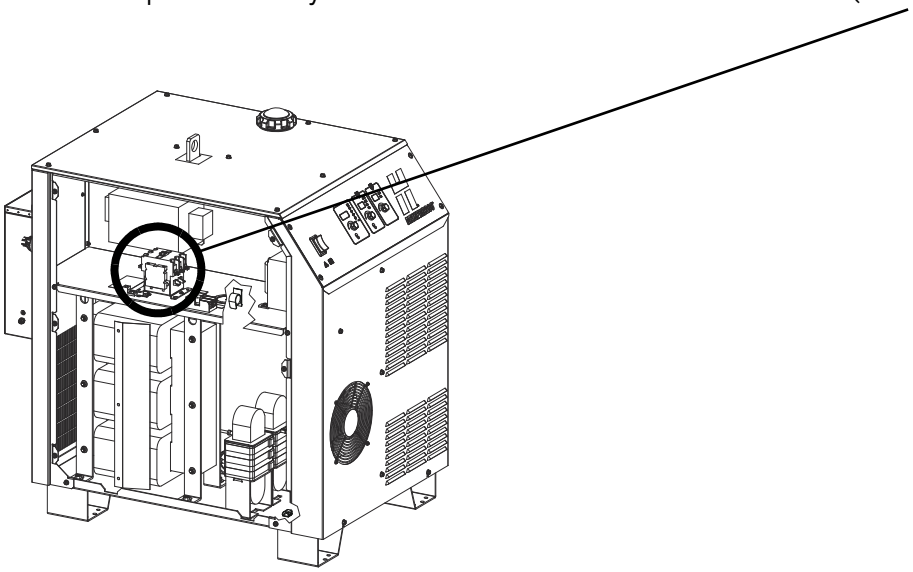
1. It is best to use clip-on test leads to keep your hands and the meter outside the power supply. Connect the meter to J9 (WORK) and J7 (NEGATIVE) on the I/O board.
2. Turn ON the power to the system.
3. The automatic chopper test will begin when the purge cycle starts. You will hear the main contactor close and 0 to 5 seconds later the meter should show 360 VDC. This is the OCV for chopper channel A. The voltage will start to decrease, then spike back up to 360 VDC again. The second reading represents the OCV for chopper channel B.



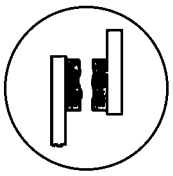


Phase loss detection

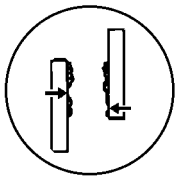
1. Turn OFF all power to the system and remove the cover from the contactor (CON1).



2. Inspect the condition of the 3 contacts for excessive wear. If one or more of the contacts are worn excessively, replace CON1 and restart the system.



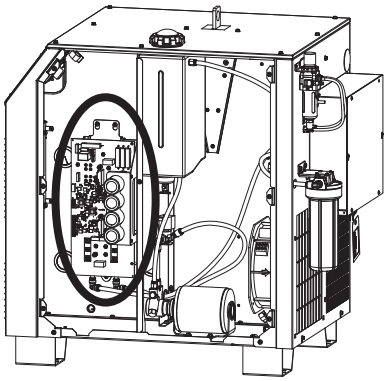
OK



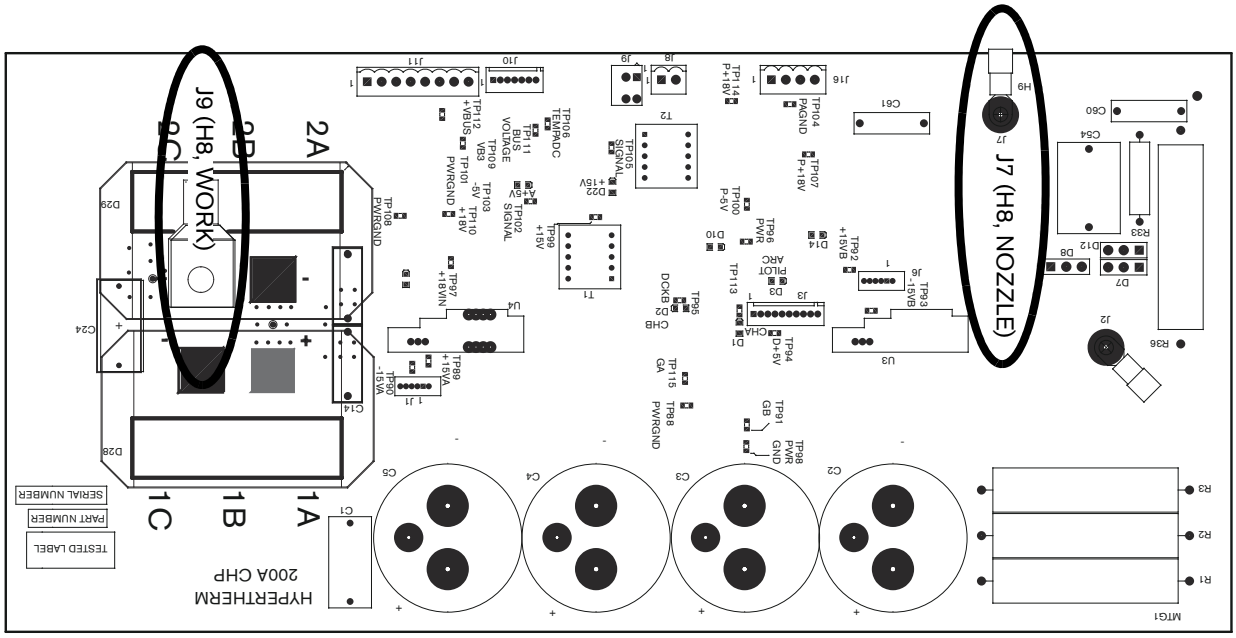
Excessive wear

Torch lead test

1. Turn OFF all power to the system.
2. Locate the chopper board.



3. Install a temporary jumper wire between J7 (H9, NOZZLE) and the work lead connection, J9 (H8, WORK) on the chopper board.



4. Measure the ohm value between the nozzle and the plate. The reading should be < 4 ohms. A measurement > 4 ohms indicates a faulty connection between the torch and I/O board, or between the I/O board and the power supply.
5. Verify that the pilot arc wire on the torch lead is not damaged. If it is damaged, replace the lead. If it is not damaged, replace the torch head.

Preventive maintenance

Introduction

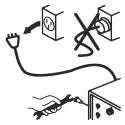
Deteriorating consumable parts life is one of the first indications that something is wrong with a plasma system. Reduced parts life increases operating costs in two ways: the operator must use more electrodes and nozzles to cut the same amount of metal, and the work of cutting must stop more often to change consumables.

Proper maintenance often eliminates the problems that shorten the life of consumable parts. Since labor and overhead can account for 80% of the cost of cutting, improved productivity can reduce cutting costs dramatically.

Preventive maintenance protocol

If inspection suggests that a component is worn and might require replacement, and you would like confirmation of your decision, please contact Hypertherm's Technical Service.

The power supply

<table>
<tr><td> </td><td> </td><td>DANGER!
ELECTRIC SHOCK CAN KILL</td></tr>
<tr><td>  </td><td colspan="2">Turn off all electrical power before removing the power supply cover and set the line disconnect switch to OFF. In the U.S., use a "lock-out and tag-out" procedure until the service or maintenance is complete. In other countries, follow appropriate local or national safety procedures.</td></tr>
</table>

1. Turn OFF the power supply and remove all side panels. Use compressed air to blow out any accumulation of dust and particulates.
2. Inspect wiring harnesses and connections for wear, damage, or loose connections. If you see any discoloration that might indicate overheating, contact Hypertherm Technical Service.
3. Inspect the main contactor for excessive pitting on the contacts, characterized by a blackened, rough surface on any of the contacts. If this condition exists, replacement is recommended.

Cooling system

4. Inspect the coolant-circulating system's filter element at the rear of the power supply. If the filter is a brownish color, replace it. Consult the Parts List in this manual for part numbers.
5. Perform a coolant flow test as described in this manual, then check for coolant leaks. Inspect these locations:
   a. The back of the power supply
   b. Ignition enclosure
   c. Torch main body

   Also, check the coolant tank for dirt and particulates. Verify that proper Hypertherm coolant is being used. Proper Hypertherm coolant (028872) is a pink liquid.

Torch main body

6. Verify that the water tube is straight and has no pitting on the end.
7. Inspect the current ring inside the torch main body. The current ring should be smooth and not pitted. If no pitting is observed, clean the current ring with a clean cotton swab and hydrogen peroxide. Do not use alcohol. Pitting on the current ring generally indicates improper maintenance (for example, lack of regular cleaning).
8. Clean all threads on the front end of the torch head with hydrogen peroxide and a cotton swab, pipe cleaner or clean cloth. Do not use alcohol. Damage to the threads usually results from not cleaning the torch and retaining cap threads properly, so that dirt and particulates accumulate in the threads.
9. Inspect the torch insulator for cracks. Replace the torch if you find cracks.
10. Inspect all o-rings on the torch body and consumables. Make sure that the correct amount of lubricant – a thin film – is applied to these o-rings. Too much lubricant may obstruct gas flows.
11. Check that the retaining or shield cap is tightened securely to the torch main body.
12. Inspect all hose fittings at the rear of the torch for wear. Damage to the fitting threads may indicate that overtightening has occurred.
13. Check that all connections between the torch and torch leads are tight, but do not overtighten. See torque specs in the *Installation* section of this manual.

When removing consumables, always place them on a clean, dry, oil-free surface, since dirty consumables may cause the torch to malfunction.

Gas flows

14. Perform the appropriate gas flow tests described under *Diagnostic functions* on page 128.

15. If the gas line pressures hold steady, perform a system gas leak test as specified in this manual.
16. Check for hose restrictions, as follows:
    a. Check all hoses to verify that they have no kinks or sharp bends, which can restrict gas flow.
    b. If the cutting table uses a power track system to support leads from the power supply to the gas console or torch, check the position of the leads in the power track to ensure the leads do not twist or kink, causing a possible restriction.

Cable connections

17. All cables should be checked for chafing or unusual wear. If the outside insulation has been cut or otherwise damaged, replace the cable.

Ignition enclosure

18. Remove the panel from the ignition enclosure and use compressed air to blow out any accumulation of dust and particulates. If moisture is present, dry the inside of the enclosure with a cloth and try to identify the source of the moisture.
19. Ensure that all wiring connections are secure. Verify that the enclosure panel fits properly.
20. Inspect the torch leads. Ensure that they are fastened tightly to the outside of the ignition console.

System grounding

21. Verify that all components of the system are individually grounded to a driven earth ground, as described in the Installation and Grounding sections of this manual.
    a. All metal enclosures, such as the power supply, ignition console and gas console, should be connected individually to a ground point. These connections should be made with 10 mm2 (#8 AWG) wire (USA), or equivalent-size wire.
22. Check the work lead (+) connection, particularly where the work lead (+) connects to the cutting table. This must be a good, clean connection because a poor connection may cause arc-transfer problems.
23. Complete the Preventive Maintenance worksheet on the next page, for future reference.

Preventive Maintenance Master Schedule

Daily:

- Verify proper inlet gas pressure.
- Verify proper gas flow settings. – Mandatory at every consumable change.
- Inspect torch and replace consumables as needed.

Weekly:

Week	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
1												
2												
3												
4												
5												

- Clean power supply with dry, oil free compressed air or vacuum.
- Verify cooling fans are working properly.
- Clean torch threads and current ring.
- Verify proper coolant level.

Semi-annually:

Year	1st Service	2nd Service

- Replace service parts per the Service part Replacement Schedule.

Annually:

Year									

- Replace service parts per the Service Part Replacement Schedule.

Preventive Maintenance Protocol Checklist

Location: _____

Contact: _____

Date: _____

Hypertherm system: _____

System Serial #: _____

System arc hours: _____
(if equipped with an hour meter)

Comments **P** – Performed **NP** – Not present on system

Power supply

- ☐P ☐NP 1. Use compressed air or a vacuum to clean out dust and particulates.
- ☐P ☐NP 2. Inspect wiring harnesses.
- ☐P ☐NP 3. Inspect main contactor.

Coolant system

- ☐P ☐NP 4. Inspect filter element.
- ☐P ☐NP 5. Perform coolant flow test. Coolant flow checked at _____ gpm (_____ l/min).
- ☐P ☐NP 6. Use compressed air or a vacuum to clean out the heat exchanger.

Torch main body

- ☐P ☐NP 7. Inspect water tube.
- ☐P ☐NP 8. Inspect current ring.
- ☐P ☐NP 9. Clean threads on torch front end.
- ☐P ☐NP 10. Inspect torch and consumable o-rings.
- ☐P ☐NP 11. Verify proper fit of retaining or shield cap.
- ☐P ☐NP 12. Inspect hose fittings.
- ☐P ☐NP 13. Inspect torch-to-torch-lead connections.

Gas flows

- ☐P ☐NP 14. Inspect plumbing from the gas supply.
  - ☐P ☐NP A. Oxygen
  - ☐P ☐NP B. Nitrogen
  - ☐P ☐NP C. Air
  - ☐P ☐NP D. Inspect supply gas filter
  - ☐P ☐NP E. Inspect hoses for restrictions
  - ☐P ☐NP F. Perform the plasma gas leak test. Pressure drops _____ psi (_____ bar) in 5 minutes.

Cable connections

- ☐P ☐NP 15. Inspect torch height control cables.

Ignition enclosure

- ☐P ☐NP 16. Inspect for moisture, dust, and particulates.
- ☐P ☐NP 17. Inspect torch leads.

System grounding

- ☐P ☐NP 18. Inspect for proper system component grounding.
- ☐P ☐NP 19. Inspect connection from cutting table to workpiece (+) lead.

General comments and recommendations:

_____

_____

_____

Preventive maintenance performed by: _____ **Date:**_____

Year 1 preventive maintenance (PM) kits

Input Voltage	Torch configuration			
	Quick-disconnect	Straight	65° Hand	90° Hand
200V – 240V	428051	428052	428053	428082
380V – 600V	428083	428084	428085	428086

Maintenance kits parts list

Each of the preventive maintenance kits contains the following parts:

Description	Quantity	Description	Quantity	Description	Quantity
Air filter element	2	Coolant solution	8	Torch main body	1
Coolant filter element	2	Main contactor	1	Torch bullet plug kit (Quick-disconnect PM kit only)	1

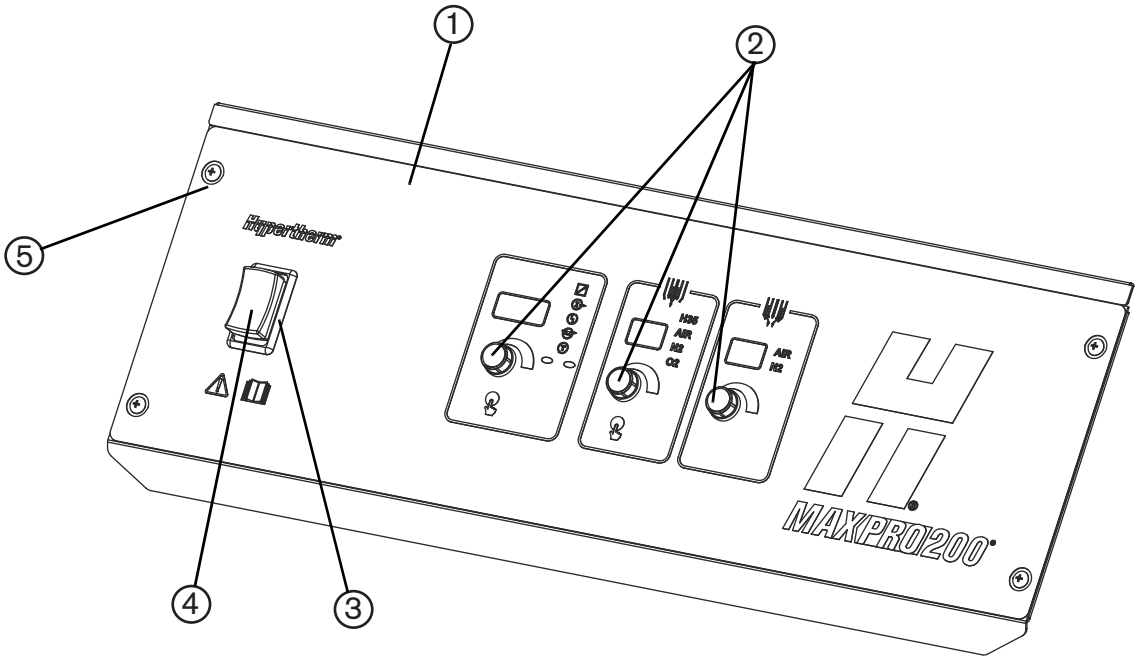
Service parts replacement schedule

Timeline		Component	Part number	Quantity
6 months / 300 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
		Torch o-ring	044026	2
		Air filter element	011093	1
1 year / 600 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
	Main contactor (choose one)	Main contactor 200V – 240V	003233	1
		Main contactor 380V – 600V	003249	
	Torch main body (choose one)	Torch main body (straight torch)	420087	1
		Torch main body (quick-disconnect torch)	220921	
		Torch main body (90° Hand torch)	420070	
		Torch main body (65° Hand torch)	420109	
		Air filter element	011093	1
1.5 years / 900 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
		Torch o-ring	044026	2
		Air filter element	011093	1
2 years / 1200 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
	Main contactor (choose one)	Main contactor 200V – 240V	003233	1
		Main contactor 380V – 600V	003249	
	Torch main body (choose one)	Torch main body (straight torch)	420087	1
		Torch main body (quick-disconnect torch)	220921	
		Torch main body (90° Hand torch)	420070	
		Torch main body (65° Hand torch)	420109	
		Air filter element	011093	1
		Pump replacement kit	428043	1
		Torch leads	System dependant	1

Timeline		Component	Part number	Quantity
2.5 years / 1500 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
		Torch o-ring	044026	2
		Air filter element	011093	1
3 years / 1800 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
	Main contactor (choose one)	Main contactor 200V – 240V	003233	1
		Main contactor 380V – 600V	003249	
	Torch main body choose one)	Torch main body (straight torch)	420087	1
		Torch main body (quick-disconnect torch)	220921	
		Torch main body (90° Hand torch)	420070	
		Torch main body (65° Hand torch)	420109	
		Air filter element	011093	1
		Fan: 450–550 cfm, 120 VAC 50–60 Hz (10 inches)	027079	1
		Heat exchanger fan (11 inches)	127091	1
3.5 years / 2100 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
		Torch o-ring	044026	2
		Air filter element	011093	1
4 years / 2400 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
	Main contactor (choose one)	Main contactor 200V – 240V	003233	1
		Main contactor 380V – 600V	003249	
	Torch main body (choose one)	Torch main body (straight torch)	420087	1
		Torch main body (quick-disconnect torch)	220921	
		Torch main body (90° Hand torch)	420070	
		Torch main body (65° Hand torch)	420109	
		Air filter element	011093	1
		Pump replacement kit	428043	1
		Torch leads	System dependant	1
		Pump motor replacement kit	428039	1
4.5 years / 2700 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
		Torch o-ring	044026	2
		Air filter element	011093	1
5 year / 3000 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
	Main contactor (choose one)	Main contactor 200V – 240V	003233	1
		Main contactor 380V – 600V	003249	
	Torch main body (choose one)	Torch main body (straight torch)	420087	1
		Torch main body (quick-disconnect torch)	220921	
		Torch main body (90° Hand torch)	420070	
		Torch main body (65° Hand torch)	420109	
		Air filter element	011093	1

Timeline		Component	Part number	Quantity
5.5 years / 3300 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
		Torch o-ring	044026	2
		Air filter element	011093	1
6 years / 3600 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
	Main contactor (choose one)	Main contactor 200V – 240V	003233	1
		Main contactor 380V – 600V	003249	
	Torch main body (choose one)	Torch main body (straight torch)	420087	1
		Torch main body (quick-disconnect torch)	220921	
		Torch main body (90° Hand torch)	420070	
		Torch main body (65° Hand torch)	420109	
		Air filter element	011093	1
		Pump replacement kit	428043	1
		Torch leads	System dependant	1
		Fan: 450–550 cfm, 120 VAC 50–60 Hz (10 inches)	027079	1
		Heat exchanger fan (11 inches)	127091	1
6.5 years / 3900 arc hours		Coolant filter element	027005	1
		Coolant solution 70/30	028872	4
		Torch o-ring	044026	2
		Air filter element	011093	1

Control panel

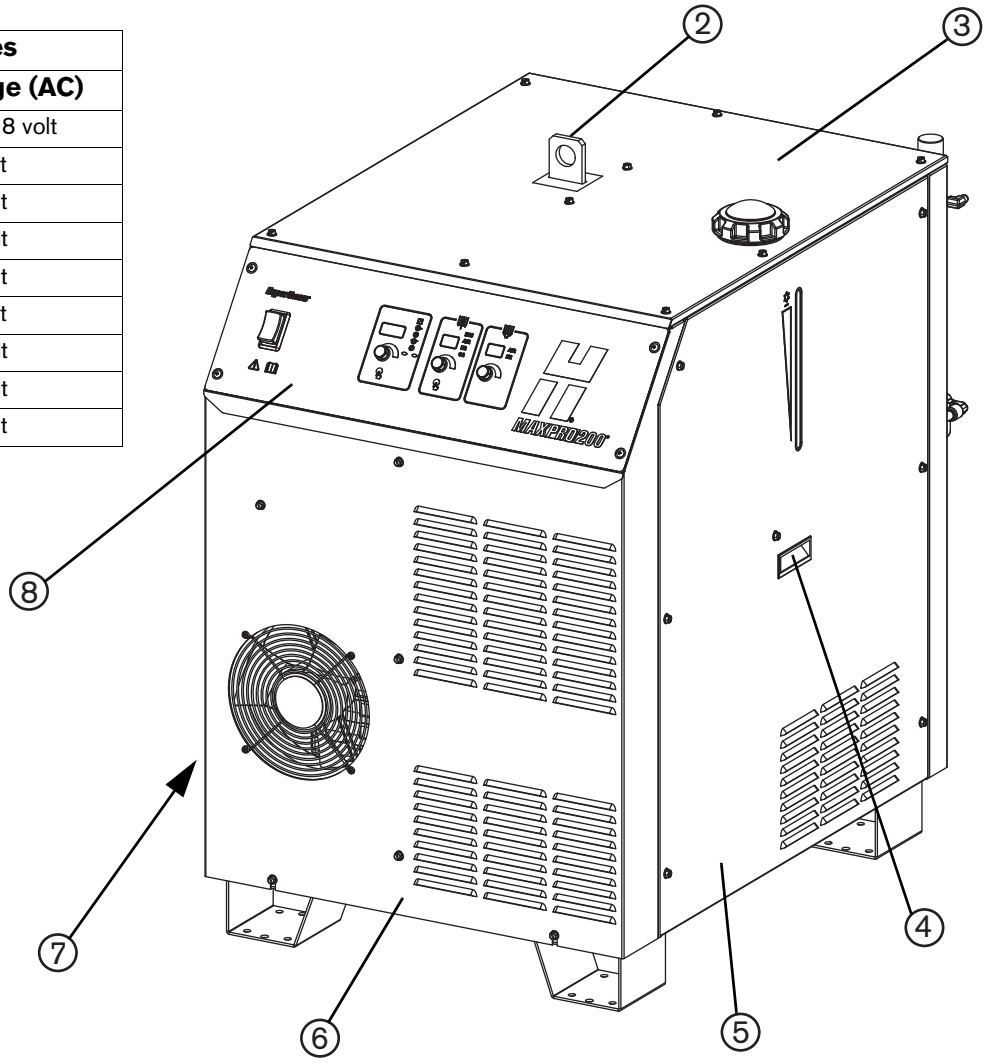


Item	Part Number	Description	Quantity
1	428032	Control panel replacement kit	1
2	108797	Knob: soft black, no pointer	3
3	007050	Rocker switch bezel	1
4	005678	Rocker switch	1
5	075237	Screw (control panel and enclosure panels): 10-32, Torx T-25	18

Power supply

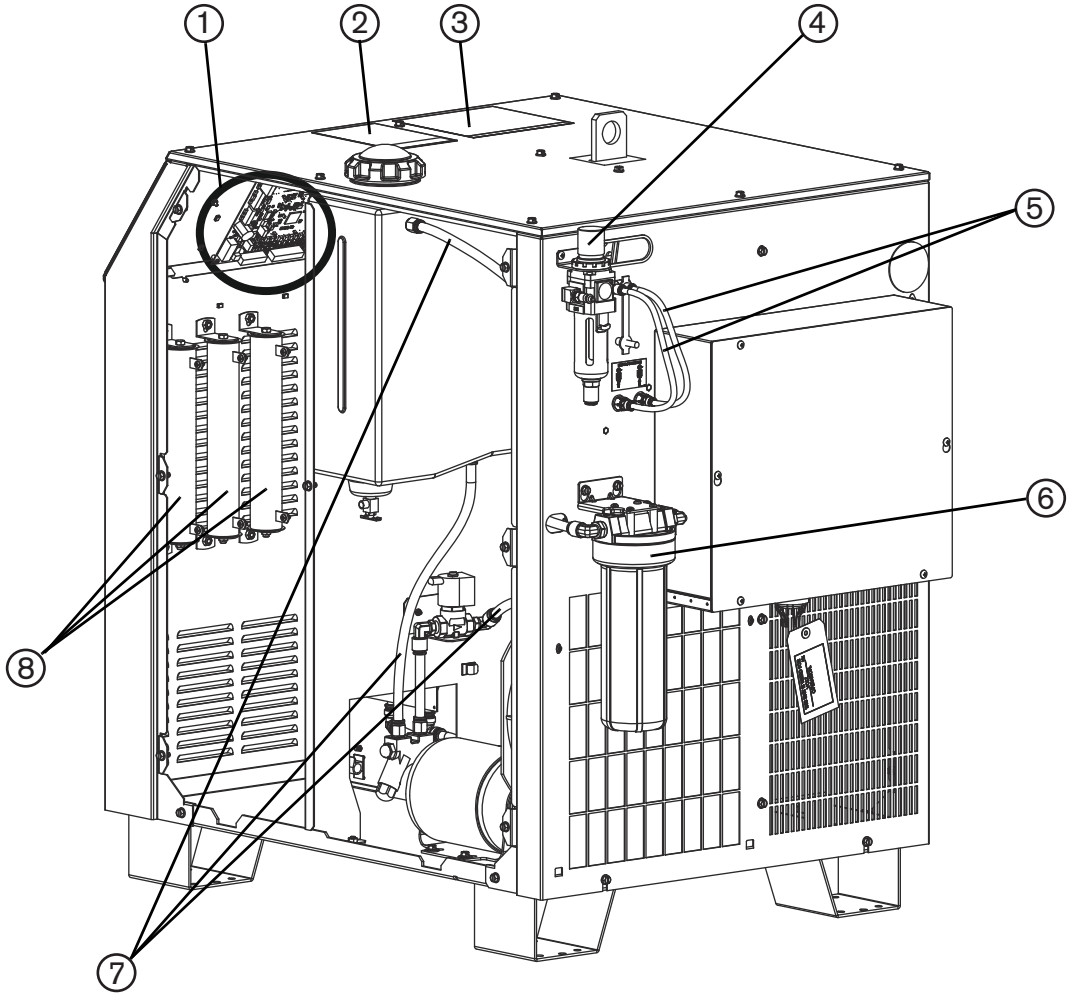
①

Power supplies	
Part number	**Voltage (AC)**
078610	200/208 volt
078611	220 volt
078612	240 volt
078613	380 volt
078614	400 volt
078615	415 volt
078616	440 volt
078609	480 volt
078617	600 volt



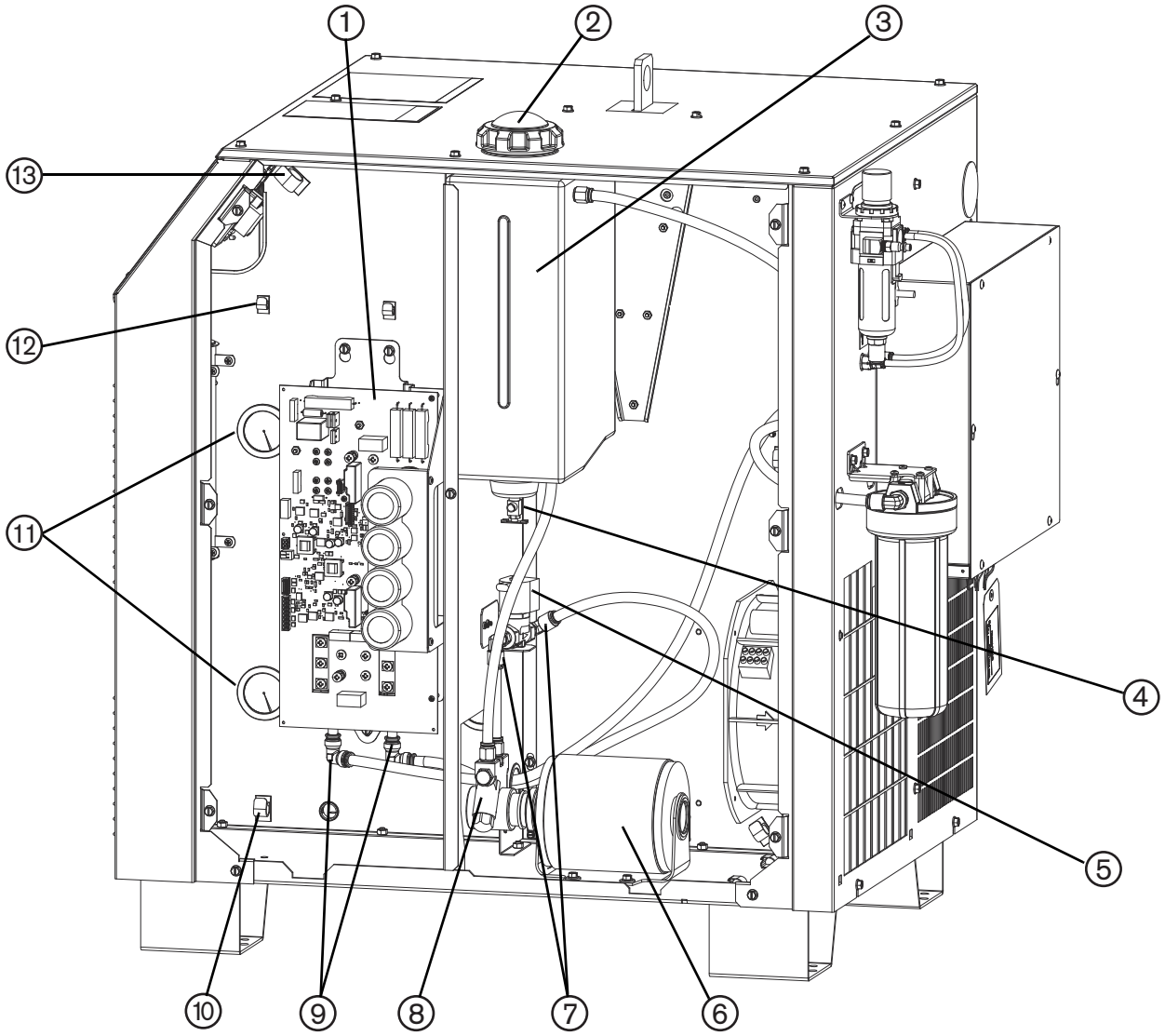
Item	Part Number	Description	Quantity
1	See chart above	Power supply	
2	428033	Lift eye replacement kit	1
3	428031	Top panel replacement kit	1
4	027967	Handle: side panels	2
5	428029	Right side panel replacement kit	1
6	101188	Front panel	1
7	428030	Left side (not shown) panel replacement kit	1
8	428032	Control panel replacement kit	1
Not shown	428035	Optional caster (wheel) kit	1

Power supply



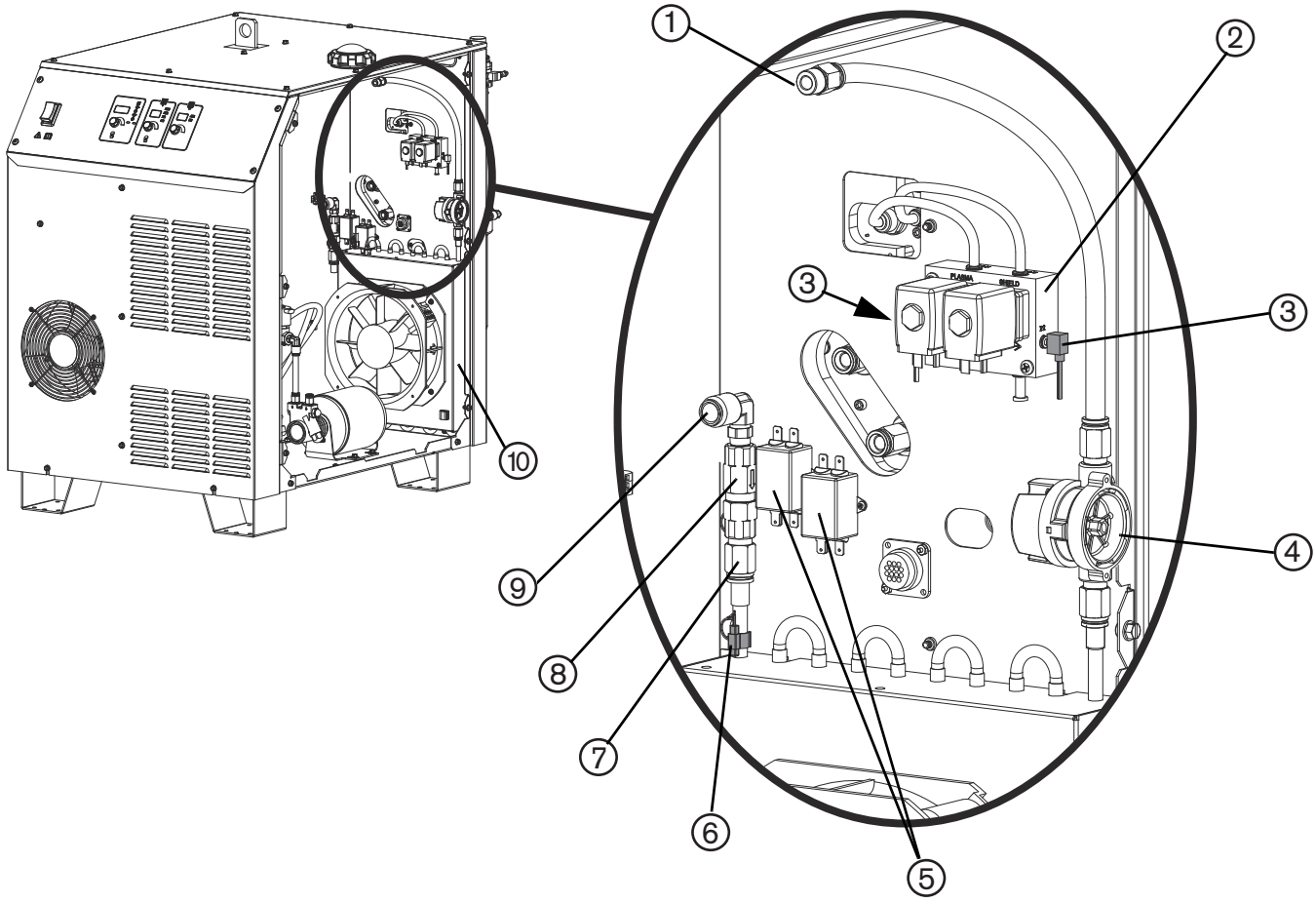
Item	Part Number	Description	Quantity
1	141171	Control Board	1
2	110261	Label: Warning instant start	1
3	010298	Label: Warnings	1
4	011114	Air filter/regulator: 7–125 psi, 1/4 inch, auto drain with valve	1
	011093	Air filter element	1
5	228862	Gas hoses kit (not all hoses shown above)	1
6	428038	Coolant filter replacement kit	1
	027005	Coolant filter element	1
7	228861	Coolant hose kit (not all hoses shown above)	1
8	109377	Resistor: 1 ohm, 500 watts	3

Power supply



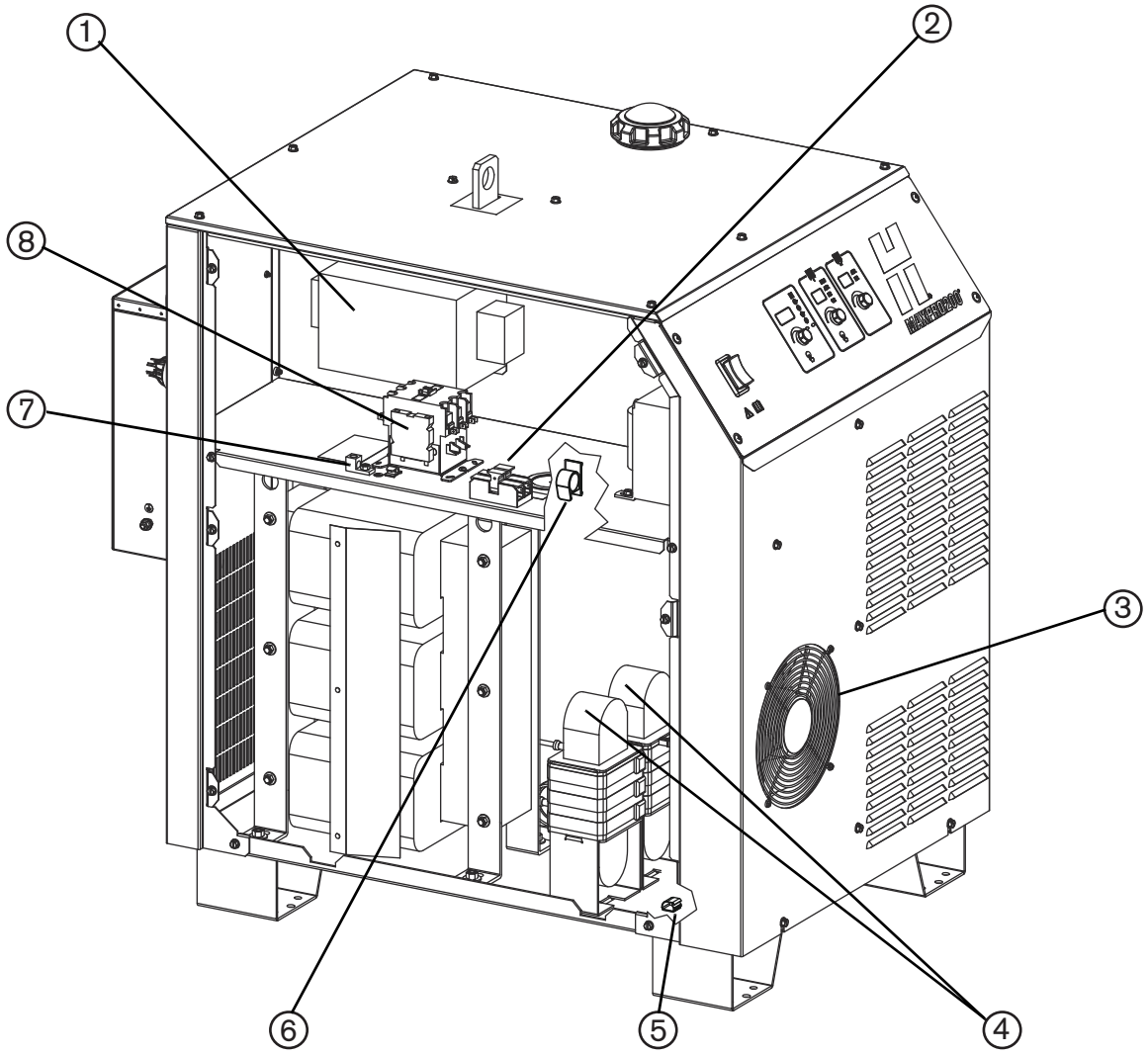
Item	Part Number	Description	Quantity
1	428036	Chopper replacement kit	1
2	127014	Coolant reservoir cap	1
3	002546	Coolant reservoir	1
4	006099	Coolant drain valve	1
5	228993	Coolant solenoid valve replacement kit	1
6	428039	Pump motor replacement kit	1
7	015665	Fitting: male elbow, 3/8 inch NPT x 1/2 inch push-in tube	2
8	428043	Pump replacement kit	1
9	015815	Fitting: elbow, 1/2 inch x 1/2 inch push-in tube, brass	2
10	074354	Cable holder: for 1/2 inch diameter cable	17
11	104407	Bushing: dust seal	6
12	074353	Cable holder: for 1/4 inch diameter cable	10
13	074355	Cable holder: for 3/4 inch diameter cable	10

Power supply



Item	Part Number	Description	Quantity
1	015669	Male connector 3/8 inch NPT x 1/2 inch	7
2	428034	Gas manifold replacement kit	1
3	428042	Pressure transducer replacement kit	2
4	428037	Flow meter replacement kit	1
5	109636	EMI filter: 250 VAC, 1 amp, 1 phase	2
6	229474	Thermistor: 3/8 inch diameter, copper pipe clip with connector	1
7	015663	Male connector 1/4 inch NPT x 1/2 inch tube	1
8	006075	Check valve	1
9	015664	Male elbow 1/4 inch NPT x 1/2 inch push-in tube	1
10	229482	Heat exchanger (with fan)	1
	127091	Heat exchanger fan only	1

Power supply

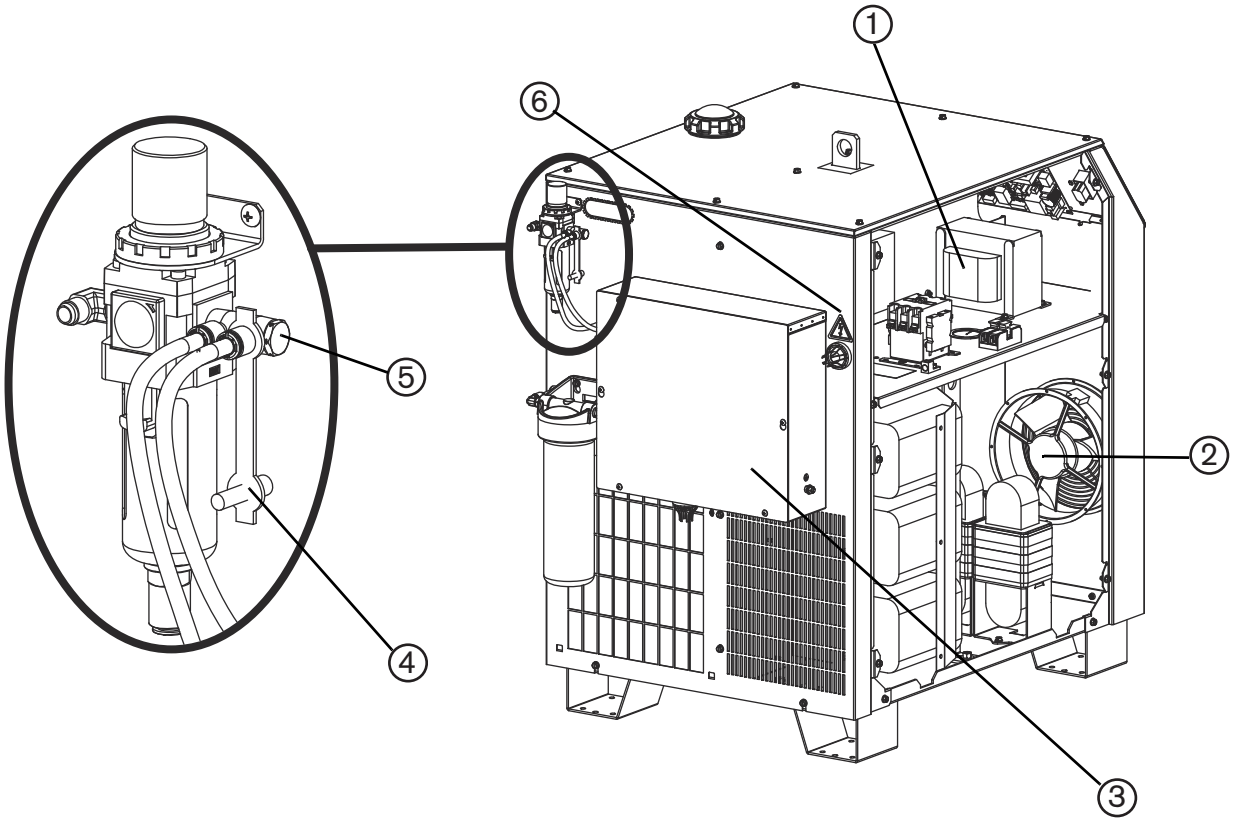


Item	Part Number	Description	Quantity
1	209177	EMI filter, 400V and 415V power supplies	
2	008301	Fuse holder	1
	108571	Fuse holder cover	1
	110513	Fuse label: F1–F2	1
	008551	Fuse: 7.5 amp, 600 volt: 380V, 400V, 415V, 440V, 480V, and 600V power supplies	2
	008709	Fuse: 20 amp, 500 volt: 200/208V, 220V, and 240V power supplies	2
3	027567	Fan guard	1
4	014373	Inductor	2
5	074212	Cable holder: self sticking, for 1/2 inch diameter cable	5
6	074356	Cable holder: for 1.0 inch diameter cable	5
7	108671	Terminal block: 14 AWG – 2/0	1
8	003249	Contactor: 380V, 400V, 415V, 440V, 480V, and 600V power supplies	1
	003233	Contactor: 200/208V, 220V, and 240V power supplies	1

Power supply

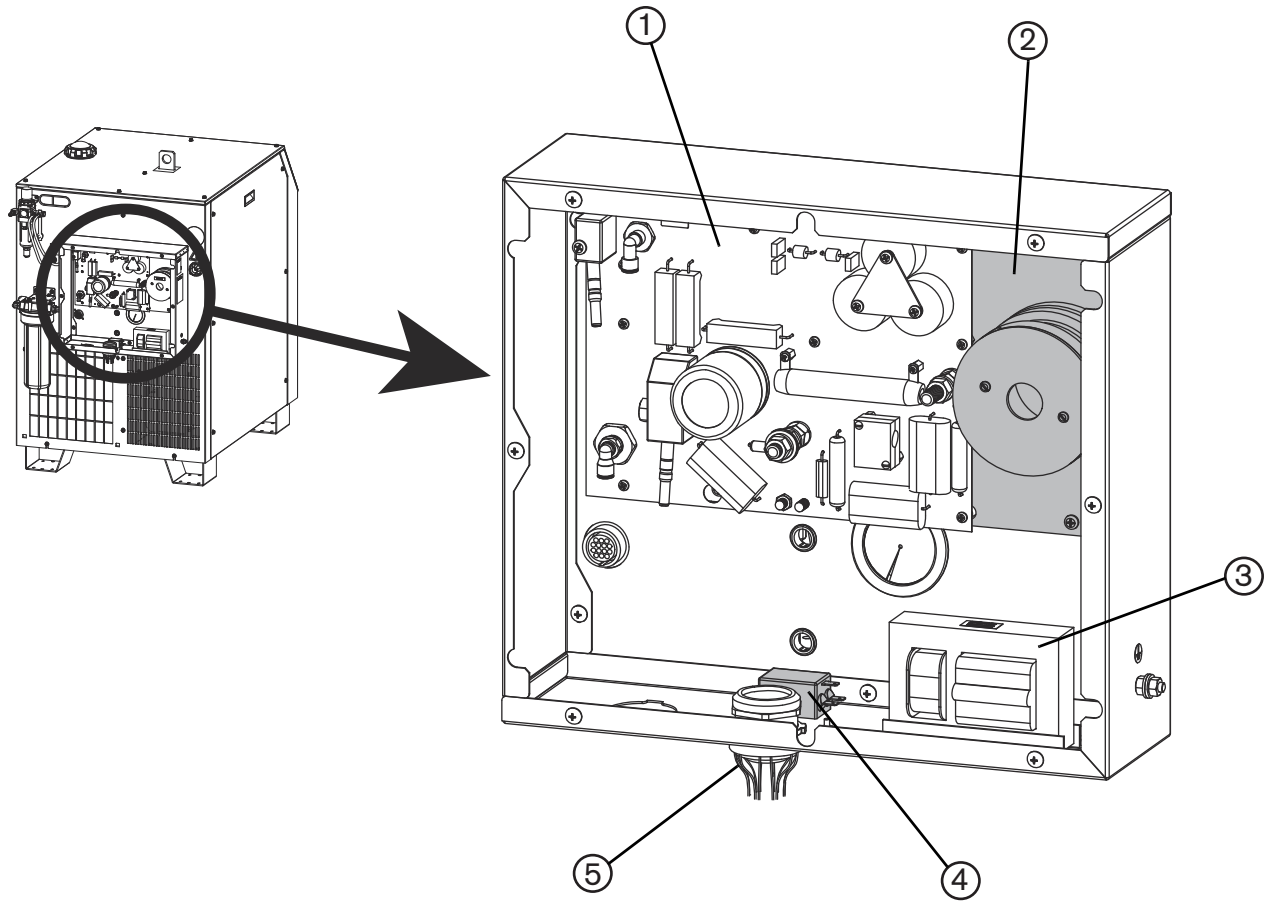
①

Control transformers			
Part number	**Description**	**Part number**	**Description**
229535	200 volt, 50–60 Hz	229538	415 volt, 50–60 Hz
229536	220 volt, 50–60 Hz	229539	440 volt, 50–60 Hz
229537	240 volt, 60 Hz	229488	480 volt, 60 Hz
229514	380 volt, 50 Hz	229540	600 volt, 50–60 Hz
229515	400 volt, 50 Hz		



Item	Part Number	Description	Quantity
1	See table above	Control transformer	1
2	027079	Fan: 450–550 cfm, 120 VAC 50–60 Hz	1
3	101205	Ignition enclosure panel (ignition)	1
4	428044	Inlet gas-plug replacement kit	1
5	015812	Adaptor:1/4 inch NPT o-ring x 5/16 inch	1
6	010875	Label: Danger voltage	1
Not shown	428054	Kit: MAXPRO200 O_2 S/A (Oxygen quick connect kit)	1
Not shown	015015	Adapter: 1/4 inch NPT, #6, Male, 90 degree	1
Not shown	015817	Adapter: 3/8 inch FNPT x 1/2 inch push-in tube	1

Ignition enclosure



Item	Part Number	Description	Quantity
1	428040	I/O PCB replacement kit	1
2	428041	I/O panel replacement kit (includes PCB)	1
3	229487	Ignition transformer	1
4	109636	EMI filter	1
5	008482	Power cord strain relief (380V, 400V, 415V, 440V, 480V, and 600V power supplies)	1
	008052	Power cord strain relief (200/208V, 220V, and, 240V power supplies)	1

Height control connection kits

Sensor THC connection kit – 428023

The kit contains a PCB (141201), and a wire harness (229554). A CNC interface cable is not supplied. The desired length should be ordered separately.

Sensor PHC connection kit – 428022

The kit contains a PHC plasma interface assembly (228256) with a 1.3 m (5 feet) interface cable attached. A CNC interface cable is not supplied. The desired length should be ordered separately.

Wire groups and harnesses

Part Number	Description
229437	Main wire harness: all power supplies
229438	Primary power wire group for 380V, 400V, 415V, 440V, 480V, and 600V power supplies
229439	EMI filter wire group for 400V and 415V power supplies
229558	Contactor wire adaptors
229561	Primary power wire group for 200/208V, 220V, and 240V power supplies

USB cables for software updates

Cable for USB update – 223291

Note: This cable allows the system software to be upgraded using a USB memory stick.

Cable for USB update – 223273

Note: This cable allows the system software to be upgraded using a laptop.

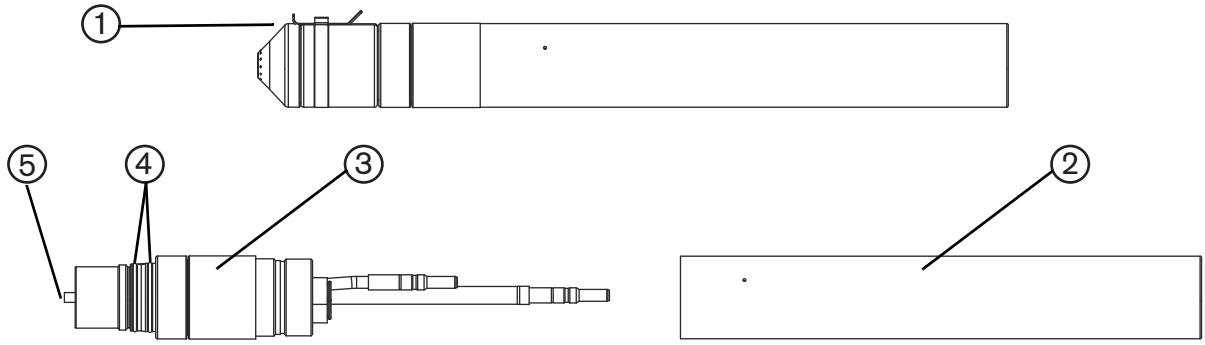
Power supply gas hose kit – 228862

The kit contains:

Part Number	Description	Length
046077	Tubing: 1/4 inch OD, blue	1 foot
046078	Tubing: 1/4 inch OD, black	1 foot
046231	Tubing: 5/16 inch OD, black	2 feet

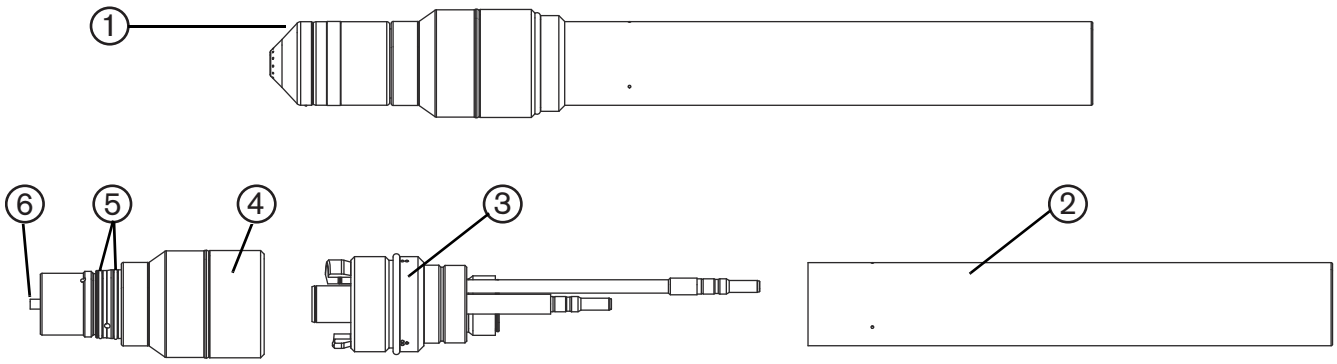
Machine torches

Straight torch



Item	Part Number	Description	Quantity
1	428024	Machine torch assembly with 2.0 inch mounting sleeve	1
	228937	Machine torch assembly with 1-3/4 inch mounting sleeve	1
2	220943	Torch Mounting sleeve: 2 inch	1
	220942	Torch Mounting sleeve: 1-3/4 inch	1
3	420087	Straight torch main body	1
4	044026	O-ring: 1.239 inch x 0.070 inch	2
5	220521	Water tube	1

Quick-disconnect torch



Item	Part Number	Description	Quantity
1	428027	Quick-disconnect torch assembly with 2.0 inch mounting sleeve	1
	428028	Quick-disconnect torch assembly with 1-3/4 inch mounting sleeve	1
2	220943	Torch Mounting sleeve: 2 inch	1
	220942	Torch Mounting sleeve: 1-3/4 inch	1
3	420033	Quick-disconnect torch receptacle	1
4	220921	Quick-disconnect torch main body	1
5	044026	O-ring: 1.239 inch x 0.070 inch	2
6	220521	Water tube	1

Leads and cables

Machine torch leads

Part Number	Length
229477	7.5 m (25 feet)
229478	15 m (50 feet)
229479	23 m (75 feet)
229480	30 m (100 feet)

CNC cables

Part Number	Length
223327	1.3 m (5 feet)
223328	3.0 m (10 feet)
223329	7.5 m (25 feet)
223330	15 m (50 feet)
223331	23 m (75 feet)
223332	30 m (100 feet)

Work leads

Part Number	Length
223335	7.5 m (25 feet)
223336	15 m (50 feet)
223337	23 m (75 feet)
223338	30 m (100 feet)

Work clamp

Part Number	Description
008539	Ground clamp

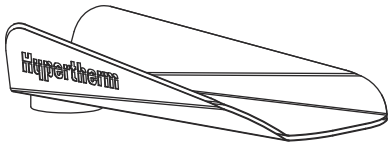
Hand torch leads

Part Number	Length
229498	7.5 m (25 feet)
229499	15 m (50 feet)
229500	23 m (75 feet)
229501	30 m (100 feet)

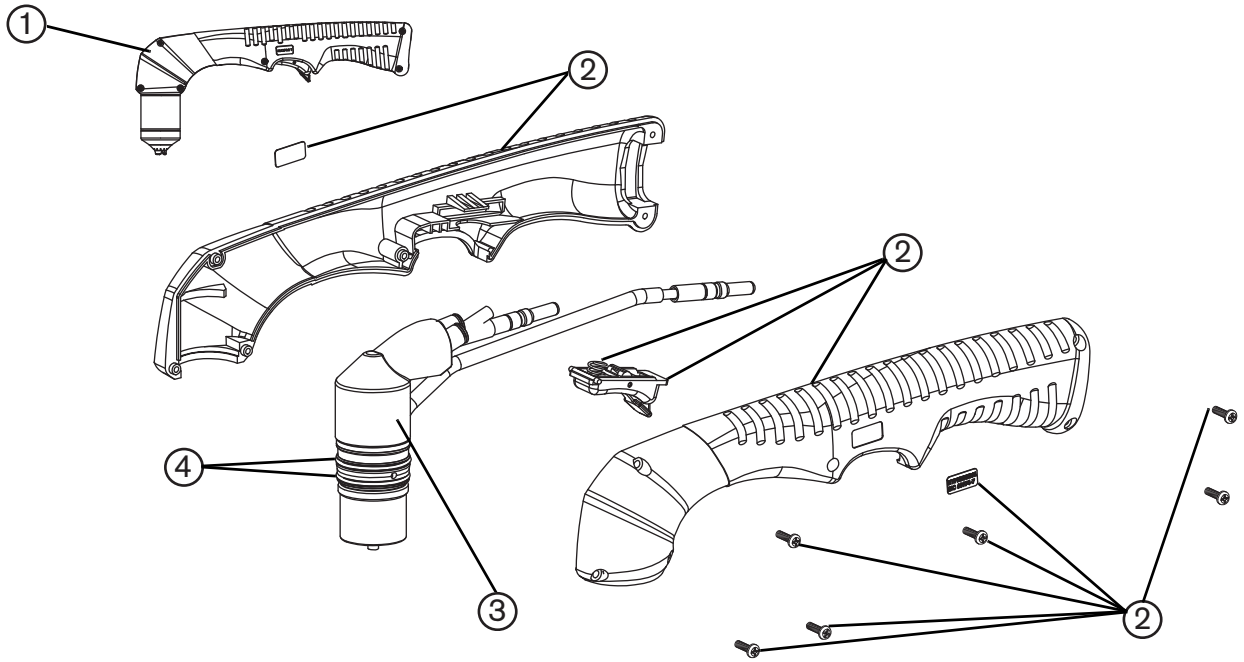
Inline valve kit

Part Number	Description
428055	Replacement for the valve located in the torch lead

Hand torch heat shield – 127389

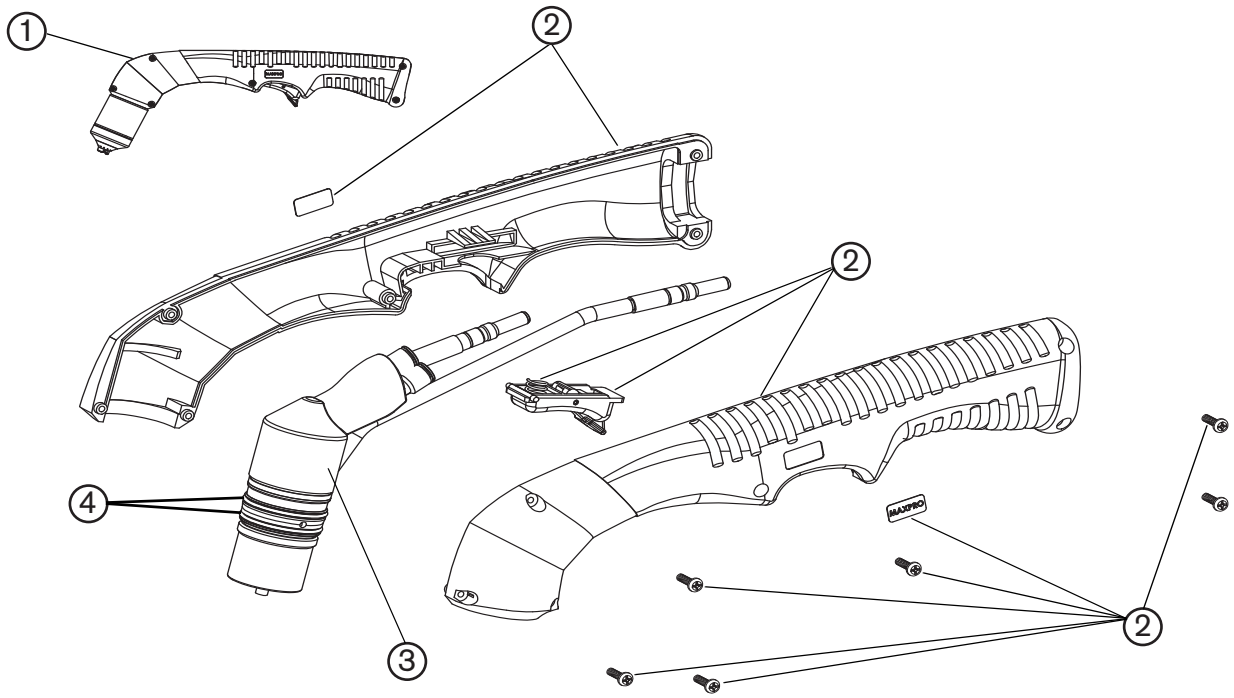


90 degree hand torch



Item	Part Number	Description	Quantity
1	420108	90 degree hand torch assembly	1
	228980	90 degree hand torch assembly with 7.5 m (25 feet) lead	1
	228981	90 degree hand torch assembly with 15 m (50 feet) lead	1
	228982	90 degree hand torch assembly with 23 m (75 feet) lead	1
	228983	90 degree hand torch assembly with 30 m (100 feet) lead	1
2	228985	Handle replacement kit	1
	001905	90 degree torch handle (left and right sides)	1
	002244	Safety trigger	1
	027254	Safety trigger spring	1
	075841	Pan head screws	6
	210185	Hand torch label	1
	210209	Hypertherm IEC label	1
3	420070	Torch main body	1
4	044026	O-ring: 1.239 inch x 0.070 inch	2

65 degree hand torch



Item	Part Number	Description	Quantity
1	420107	65 degree hand torch assembly	1
	228976	65 degree hand torch assembly with 7.5 m (25 feet) lead	1
	228977	65 degree hand torch assembly with 15 m (50 feet) lead	1
	228978	65 degree hand torch assembly with 23 m (75 feet) lead	1
	228979	65 degree hand torch assembly with 30 m (100 feet) lead	1
2	228986	Handle replacement kit	1
	001906	65 degree torch handle (left and right sides)	1
	002244	Safety trigger	1
	027254	Safety trigger spring	1
	075841	Pan head screws	6
	210184	Hand torch label	1
	210209	Hypertherm IEC label	1
3	420109	Torch main body	1
4	044026	O-ring: 1.239 inch x 0.070 inch	2

Consumable parts kits

Mechanized torch consumable kit – 428013

Part number	Description	Quantity
020415	Electrode: 200A and 130A, N_2	2
027055	Silicone lubricant: 1/4 ounce tube	1
044026	O-ring: 1.239 x 0.070	2
104119	Consumable tool	1
220487	Electrode: 130 A, O_2/Air	4
220488	Swirl ring: 130 A, O_2/Air and 200 A, Air	2
220491	Shield:130 A, O_2	1
220521	Water tube	1
220528	Electrode 50 A, O_2/Air	4
220529	Swirl ring: 50 A, O_2/Air and 130A or 200A, N_2	1
220532	Shield: 50A, O_2/Air	1
220536	Shield:130A, Air/N_2	1
220831	Nozzle: 200A, O_2	2
220832	Shield: 200A, O_2	1
220834	Swirl ring: 200A, O_2	1
220890	Nozzle: 50A, Air	2
220891	Nozzle: 50A, O_2	2
220892	Nozzle: 130A, Air/N_2	2
220893	Nozzle: 130A, O_2	2
220935	Shield cap: O_2/Air/N_2, clockwise	1
220936	Shield cap: O_2/Air/N_2, clockwise, with IHS tab	1
220937	Electrode: 200, O_2/Air	6
420044	Nozzle: 200A, Air/N_2	6
420045	Shield: 200A, Air/N_2	2
428054	Kit: MAXPRO200 O_2 S/A (Oxygen quick connect kit)	1
881430	MAXPRO200 machine torch brochure	1

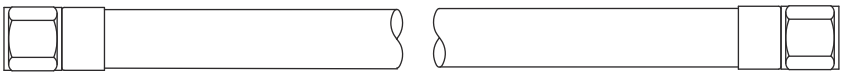
Hand torch consumable kit – 428014

Part number	Description	Quantity
027055	Silicone lubricant: 1/4 ounce tube	1
044026	O-ring: 1.239 x 0.070	2
104119	Consumable tool	1
220488	Swirl ring: 130A, O_2/Air and 200 A, Air	2
220521	Water tube	1
220831	Nozzle: 200A, O_2	2
220834	Swirl ring: 200A, O_2	1
220935	Shield cap: O_2/Air/N_2, clockwise	2
220937	Electrode: 200A, O_2/Air	8
420044	Nozzle: 200A, Air/N_2	4
420058	Shield: 200A, Air/N_2	2
420059	Shield: 200A, O_2	1
420066	Nozzle: 200A, Air, Gouging	2
420067	Shield: 200A, Air, Gouging	2
428054	Kit: MAXPRO200 O_2 S/A (Oxygen quick connect kit)	1
881440	MAXPRO200 hand torch brochure	1

Supply gas hoses

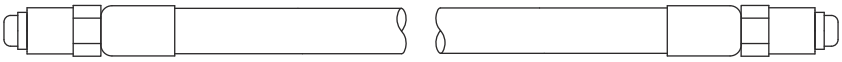
Caution: Never use teflon tape on any joint preparation

Oxygen



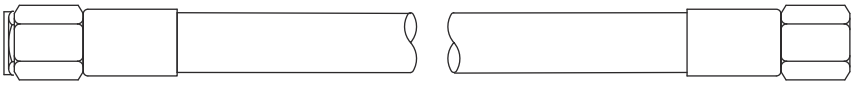
Part number	Length	Part number	Length
024607	3 m (10 ft)	024738	25 m (82 ft)
024204	4.5 m (15 ft)	024450	35 m (115 ft)
024205	7.5 m (25 ft)	024159	45 m (150 ft)
024760	10 m (35 ft)	024333	60 m (200 ft)
024155	15 m (50 ft)	024762	75 m (250 ft)
024761	20 m (65 ft)		

Nitrogen



Part number	Length	Part number	Length
024210	3 m (10 ft)	024739	25 m (82 ft)
024203	4.5 m (15 ft)	024451	35 m (115 ft)
024134	7.5 m (25 ft)	024120	45 m (150 ft)
024211	10 m (35 ft)	024124	60 m (200 ft)
024112	15 m (50 ft)	024764	75 m (250 ft)
024763	20 m (65 ft)		

Air



Part number	Length	Part number	Length
024671	3 m (10 ft)	024740	25 m (82 ft)
024658	4.5 m (15 ft)	024744	35 m (115 ft)
024659	7.5 m (25 ft)	024678	45 m (150 ft)
024765	10 m (35 ft)	024680	60 m (200 ft)
024660	15 m (50 ft)	024767	75 m (250 ft)
024766	20 m (65 ft)		

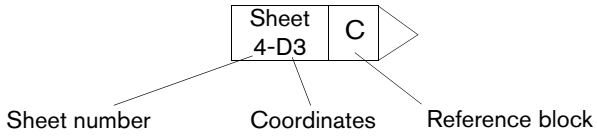
Recommended spare parts

Part number	Description	Quantity
003233	Contactor: 200/208V, 220V, and 240V power supplies	1
003249	Contactor: 380V, 400V, 415V, 440V, 480V, and 600V power supplies	1
011093	Air filter element	1
027005	Coolant filter element	1
027055	Silicone lubricant: 1/4 ounce tube	1
027079	Fan: 450–550 cfm, 120 VAC 50–60 Hz	1
028872	Coolant solution, 70/30 PG, 1 gallon	4
127091	Heat exchanger fan	1
141171	Control Board	1
220921	Quick-disconnect torch main body	1
220942	Torch Mounting sleeve: 1-3/4 inch	1
220943	Torch Mounting sleeve: 2 inch	1
420033	Quick-disconnect torch receptacle	1
420070	90 degree torch main body	1
420087	Straight torch main body	1
420109	65 degree torch main body	1
428034	Gas manifold replacement kit	1
428035	Castor wheel kit	1
428036	Chopper replacement kit	1
428037	Flow meter replacement kit	1
428038	Coolant filter replacement kit	1
428039	Pump motor replacement kit	1
428040	I/O PCB replacement kit	1
428041	I/O panel replacement kit (includes PCB)	1
428042	Pressure transducer replacement kit	1
428043	Pump replacement kit	1
428044	Inlet gas-plug replacement kit	1
428054	Kit: MAXPRO200 O_2 S/A (Oxygen quick connect kit)	1
428055	In-line valve replacement kit	1

Wiring Diagrams

This section contains the wiring diagrams for the system. When you trace a signal path, or reference the *Parts List* or *Troubleshooting* sections, the following conventions will help you understand the organization of the wiring diagrams:

- Sheet numbers are located in the lower, right-hand corner of each page.
- References to other pages use the following connection symbol:



Use the sheet number to find the reference sheet. Line up the coordinates A–D on the Y axis and numbers 1–4 on the X axis of each sheet to find the reference blocks (similar to a road map).

Wiring diagram symbols

Battery

Cap, polarized

Cap, not polarized

Cap, feed-through

Circuit breaker

Coax shield

Current sensor

Current sensor

DC supply

Diode

Door interlock

Fan

Feedthrough LC

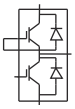
Filter, AC

Fuse

Ground clamp

Ground, chassis

Ground, earth


IGBT

Inductor

LED

Lamp

MOV

Pin

Socket

Plug

PNP transistor

Potentiometer

Push button, normally closed

Push button, normally open

Receptacle

Relay, coil

Relay, normally closed

Relay, normally open

Relay, solid state, AC

Relay, solid state, DC

Relay, solid state, dry

Resistor

SCR

Shield

Shunt

Spark gap

Switch, flow

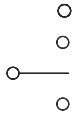
Switch, level, normally closed

Switch, pressure, normally closed

Switch, pressure, normally open

Switch, 1 pole, 1 throw

Switch, 1 pole, 2 throw


Switch, 1 pole, 1 throw, center off

Switch, temperature, normally closed

Switch, temperature, normally open

Terminal block

Time delay closed, NC/off

Time delay open, NO/off

Time delay open, NC/on

Time delay closed, NO/off

Transformer

Transformer, air core

Transformer, coil

Triac

VAC source

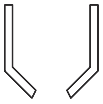
Valve, solenoid

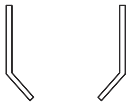
Voltage source

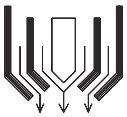
Zener diode

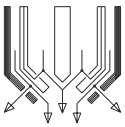
Torch symbols

Electrode


Nozzle


Shield

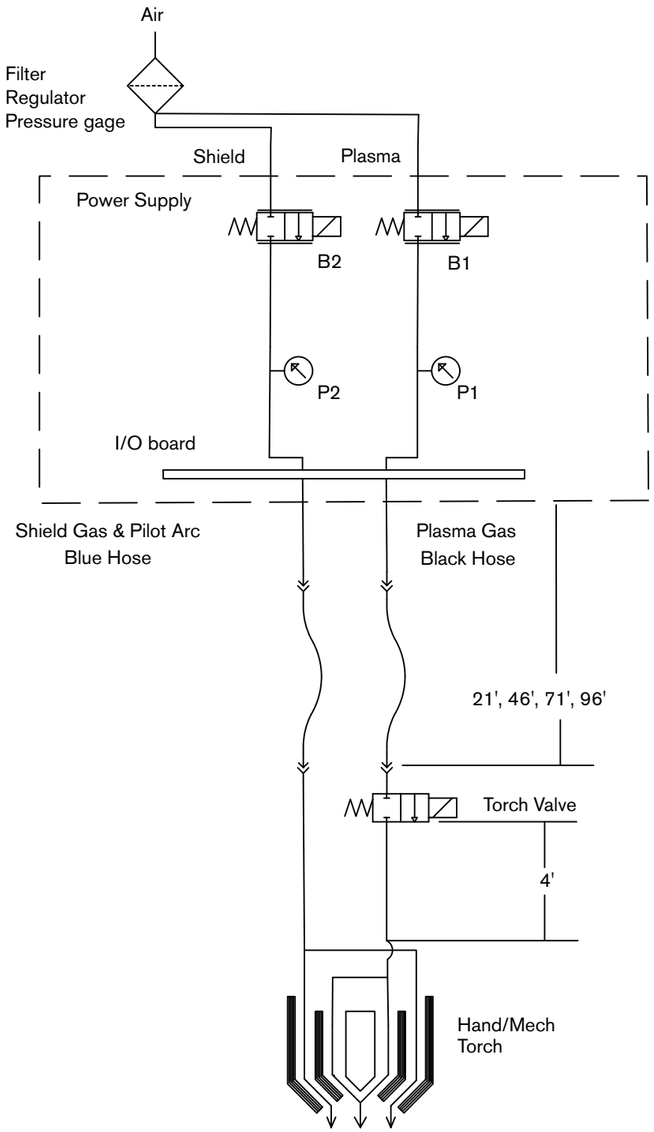

Torch


Torch, HyDefinition™

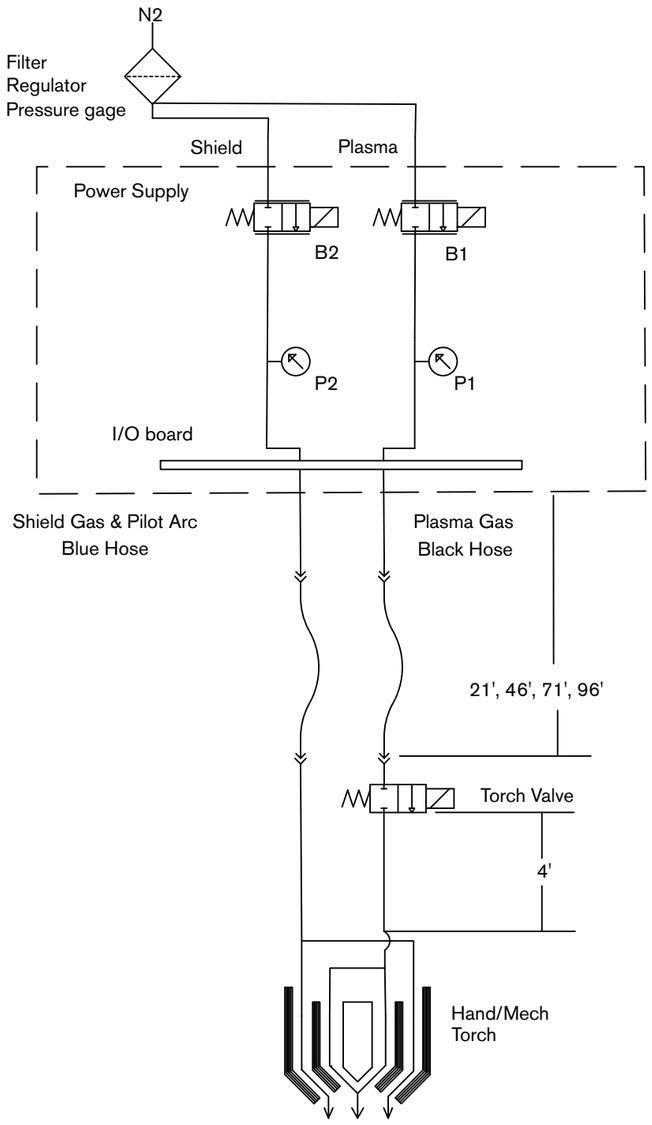
MAXPRO 200

Gas Schematic

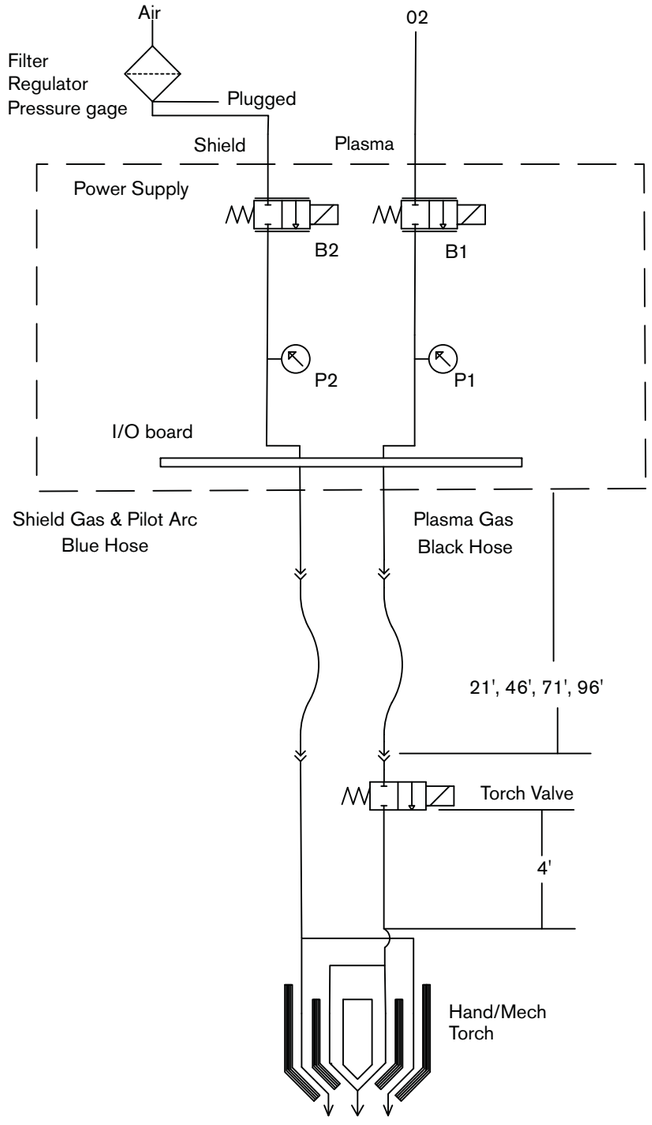
Air/Air

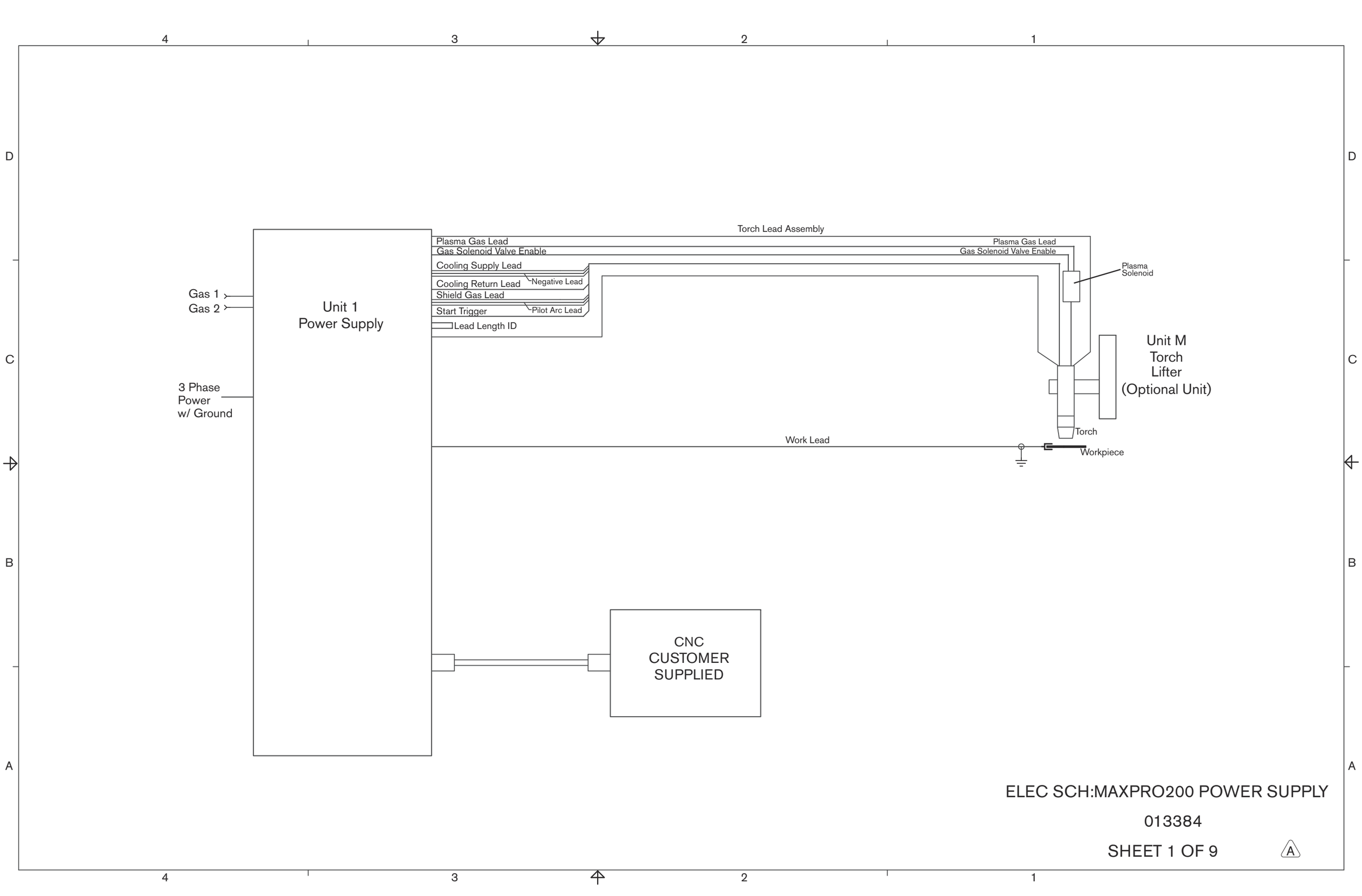


N2/N2



O2/AIR

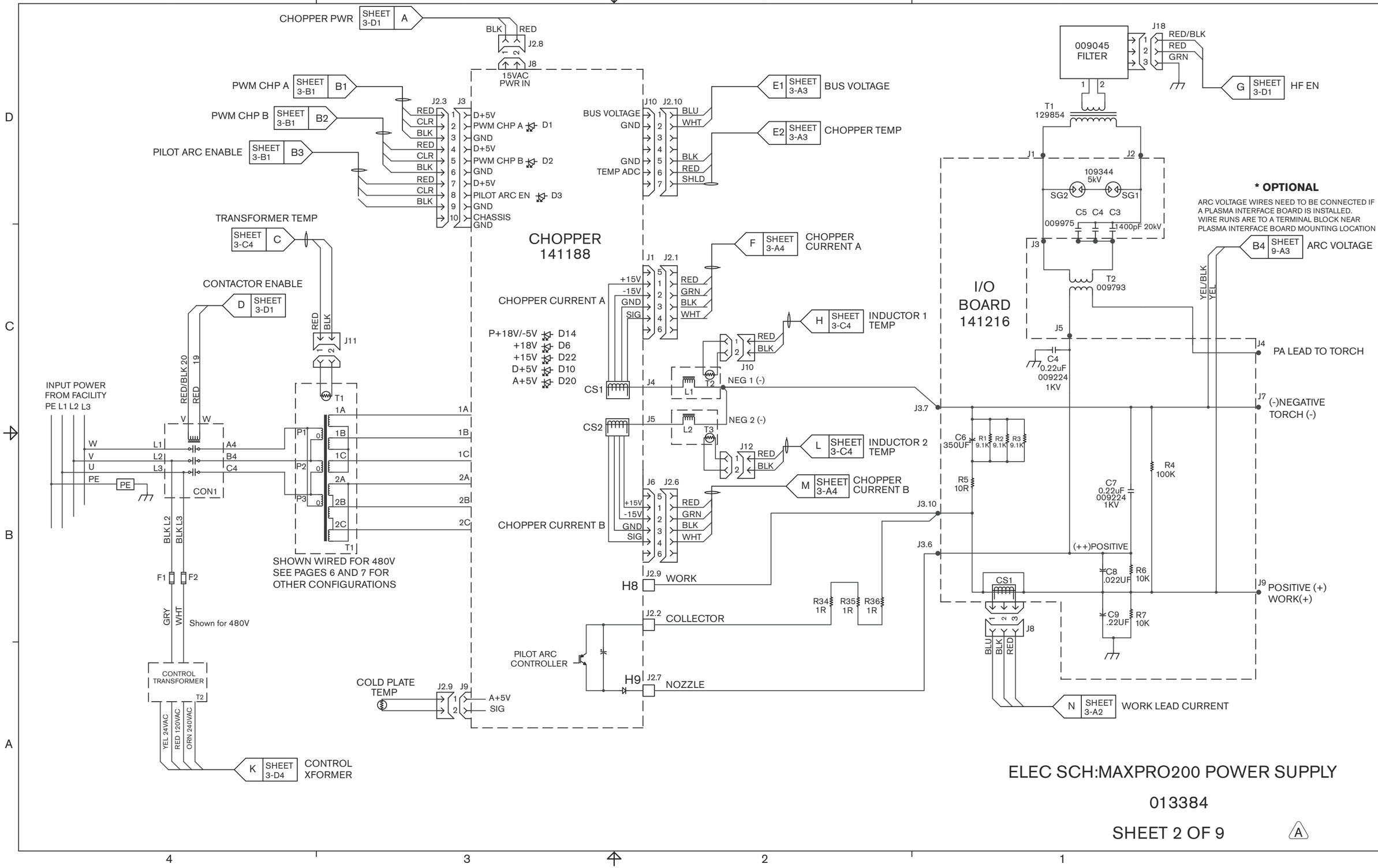




ELEC SCH:MAXPRO200 POWER SUPPLY

013384

SHEET 1 OF 9 A



ELEC SCH:MAXPRO200 POWER SUPPLY

013384

SHEET 2 OF 9 (A)

POWER SUPPLY CONTROL BOARD
141201

D26 15V
D31 240V FUSED AC INPUT
D33 3.3V
D37 5V
D40 24V
D41 120V FUSED AC INPUT
D42 240V INPUT DETECTED
D44 120V INPUT DETECTED

D35 CHOPPER A OVER CURRENT
D100 CHOPPER B OVER CURRENT

CONTROL TRANSFORMER
SHEET 2-A4 K
J1.9 J9
24VAC YEL
24VAC YEL
RED
120VAC RED
ORN
240VAC ORN
24VAC
120VAC F2
240VAC F1
120VAC SWITCHED
240VAC SWITCHED
GND
K1

J4 POWER SWITCH
OPTIONAL CUSTOMER REMOTE ON/OFF
J1.8 J8
BLK
BLU
WHT
BLK
YLW
RED
+24V
POWER ON
STANDBY

TRANSFORMER TEMP SHEET 2-D4 C
INDUCTOR 1 TEMP SHEET 2-C2 H
INDUCTOR 2 TEMP SHEET 2-B2 L
J1.12 J12
RED BLK
RED BLK
RED BLK
FA3.3V
TRANSFORMER TEMPERATURE
INDUCTOR 1 TEMPERATURE
INDUCTOR 2 TEMPERTURE

+15V
P1
BRN BLU BLK
J1.11 J11
RED BLK YLW
PLASMA PRESSURE
P2
BRN BLU BLK
J1.13 J13
RED BLK YLW
SHEILD PRESSURE

F+15V
CHOPPER CURENT A
F-15V
CHOPPER CURENT B
CHOPPER TEMP
BUS VOLTAGE
J15
J1.15
RED GRN BLK WHT RED GRN BLK WHT RED BLK RED WHT BLU

CHOPPER CURENT A SHEET 2-C2 F
CHOPPER CURENT B SHEET 2-B2 M
CHOPPER TEMP SHEET 2-D2 E2
BUS VOLTAGE SHEET 2-D2 E1

FA3.3V
PILOT ARC TEMP
COOLANT TEMPERATURE
J18
J1.18
WHT BLU
J9
COOLANT TEMP

CLT +15V
COOLANT FLOW
WL +15V
WORK LEAD CURRENT
D68
D65
J21
J1.21
RED BLK CLR RED BLK BLU
FL1
WORK LEAD CURRENT SHEET 2-A1 N

J22 J1.22
+15VAC_2
RED
BLK

J14 J1.14
D51 CONTACTOR ENABLE
D46 HIGH FREQ ENABLE
MAGNETICS FANS
AC RTN
120VAC FUSED
240VAC RELAY
240VAC SWITCH OUT
D70 PUMP MOTOR ENABLE
RED/BLK
RED
WHT
BLK

A SHEET 2-D3 CHOPPER POWER
D SHEET 2-D4 CONTACTOR ENABLE
G SHEET 2-D1 HIGH FREQUENCY ENABLE
TRANSFORMER FAN
J14
PS
PUMP MOTOR
CLT SOL
J13
J17
HEAT XCHANGER FAN
B5 SHEET 9-C1 GAS CONSOLE/ PLASMA INTRFC

J16 J1.16
+24V
D104 PLASMA VALVE PWM
D105 SHIELD VALVE PWM
+24V
P+5V
D106 TORCH VALVE ENABLE
D101 CHOPPER A PWM
D102 CHOPPER B PWM
D103 PILOT ARC ENABLE
RED
BLK
CLR
SV1
PLASMA VALVE SV1
SV2
SHIELD VALVE SV2
B1 SHEET 2-D3 PWM CHP A
B2 SHEET 2-D3 PWM CHP B
B3 SHEET 2-D3 PILOT ARC ENABLE

J17
TCHVLV+
TCHVLV-
J1.17
RED BLK
Z SHEET 4-A4 TORCH VALVE

ELEC SCH:MAXPRO200 POWER SUPPLY
013384
SHEET 3 OF 9
A

POWER SUPPLY CONTROL
141171

J1 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
+3.3V
JTMS-SWDIO
JTMS-SWCLK
JTD0
JTDI
NRST
JCLK PE2
JCLK PE3
JCLK PE4
JCLK PE5
JCLK PE6

JTAG MICRO

J20 1 2 3 4 5 6 7 8 9 10
ISPTCK
ISPTMS
ISPTDI
+3.3V
ISPTDO

JTAG CPLD

J3
SDIO D2 1
SDIO D3 2
SDIO CMD 3
+3.3V 4
SDIO CK 5
6
SDIO D0 7
SDIO D1 8
SDIO CD 9
10

USB MICRO SD

J19
USB VBUS 1
USB DM 2
USB DP 3
USB ID 4
USB GND 5
6
7

USB OTG

SEE PAGE 9 FOR CONNECTION TO SENSOR PHC. FOR CONNECTIONS TO A CNC PLEASE REFERANCE THEIR MANUAL

J6
1 IN START + — D6
2 CNC START -
3 CNC HOLD + — D9
4 CNC HOLD -
5 CNC MOTION + — D12
6 CNC MOTION -
7 CNC ERROR + — D14
8 CNC ERROR -
CNC HOLD OUT+ — D15
CNC HOLD OUT-

CNC INTERFACE

MANUAL TORCH START — SHEET 4-A2 — Y

J1.2 J2
RED 1 — CNC START +
WHT 2 — IN START +
BLK 3 — IN START -
BLK 4
BLK 5 — +24V
BLK 6
BLK 7 — TORCH ID0 — D1
RED 8 — TORCH ID1 — D2
GRN 9 — TORCH ID2 — D3
WHT 10 — TORCH ID3 — D4
PWR GND

TORCH INTERFACE

J5
RS422 TX- 1
RS422 RX- 2
RS422 TX+ 3
RS422 GND 4
5
RS422 RX+ 6
7
8
9
10
11

RS422

D16 CAN RX
D17 CAN TX

CAN

J7 1 2 3 4 5
CAN +24V
CANH
CANL

TORCH VALVE — SHEET 3-B1 — Z
RED
BLK
GRN/YLW
FILTER

FILTER

Y — SHEET 4-C3 — MANUAL TORCH START
RED
BLK
WHT

J7 14 13 12 11 10 9 8 7 6 5 4 3 2 1
BLK RED WHT GRN RED BLK BLK BLK BLK WHT RED
TORCH VLV -
TORCH VLV +
ID3
ID2
ID1
ID0
GND
GND
IN START -
IN START +
CNC START +

POWER SUPPLY TO TORCH LEADS

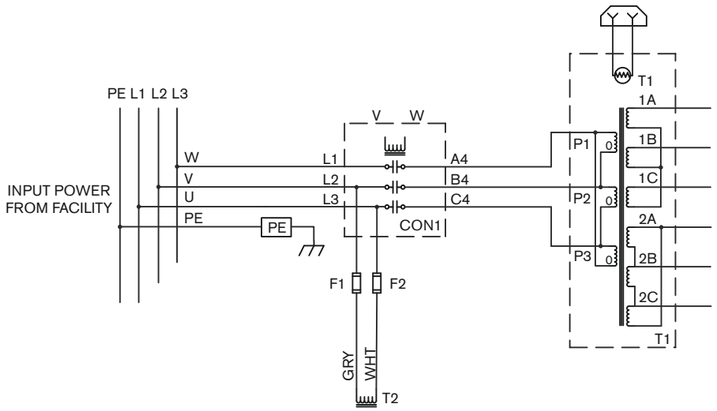
MECHANIZED TORCH: PIN 1 SHORTED TO PIN 2
MANUAL TORCH: START SWITCH ACROSS PIN 1 AND PIN 3

ELEC SCH:MAXPRO200 POWER SUPPLY

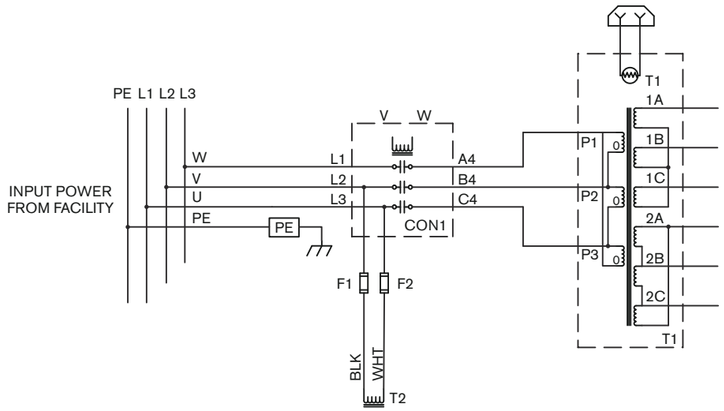
013384

SHEET 4 OF 9 (A)

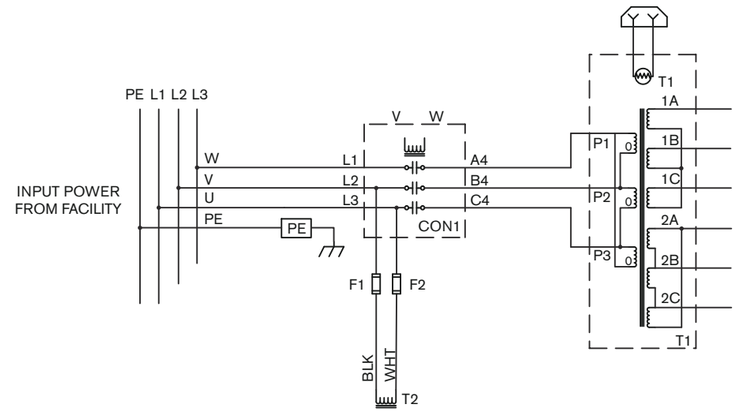
WIRED FOR 480V 60HZ



WIRED FOR 240V 60HZ



WIRED FOR 200V 50-60HZ



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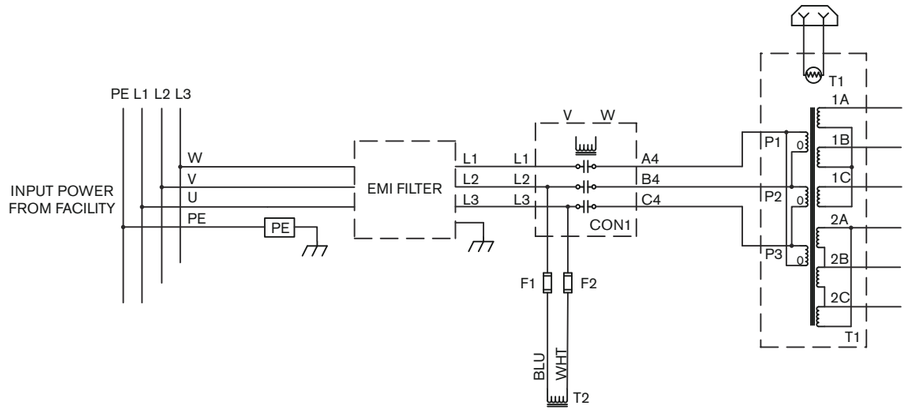
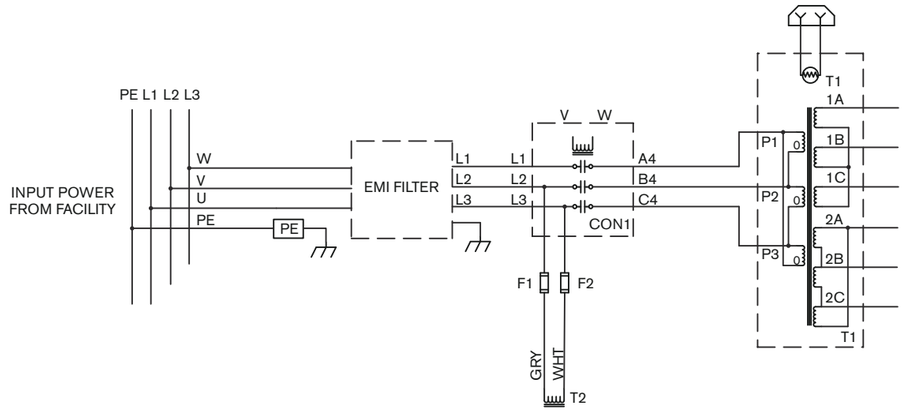


WIRED FOR 415V 50-60HZ



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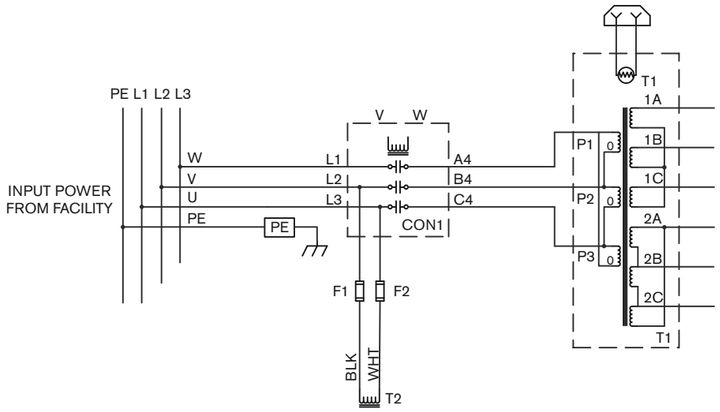
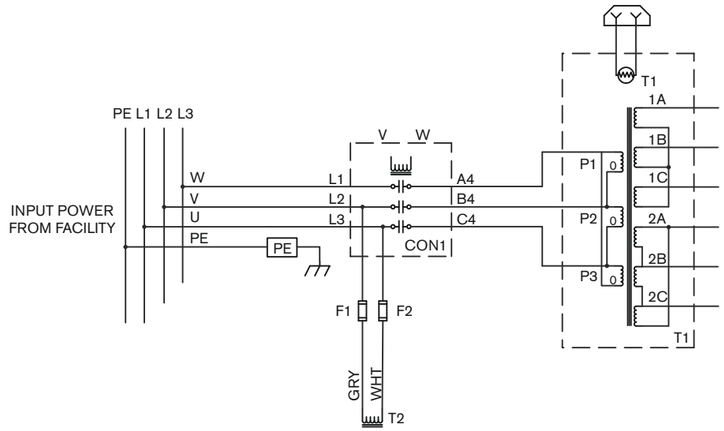
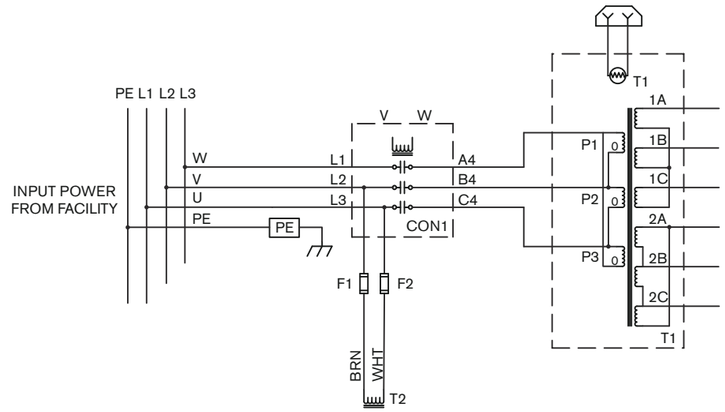
WIRED FOR 440V 50-60HZ



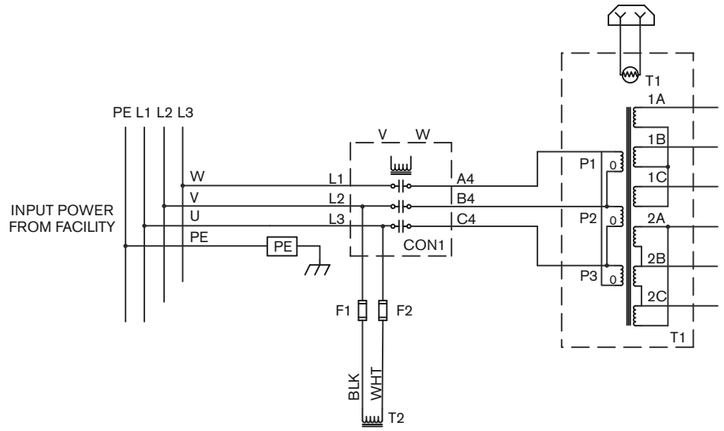
WIRED FOR 600V 60HZ



WIRED FOR 220V 50-60HZ



WIRED FOR 380V 50-60HZ



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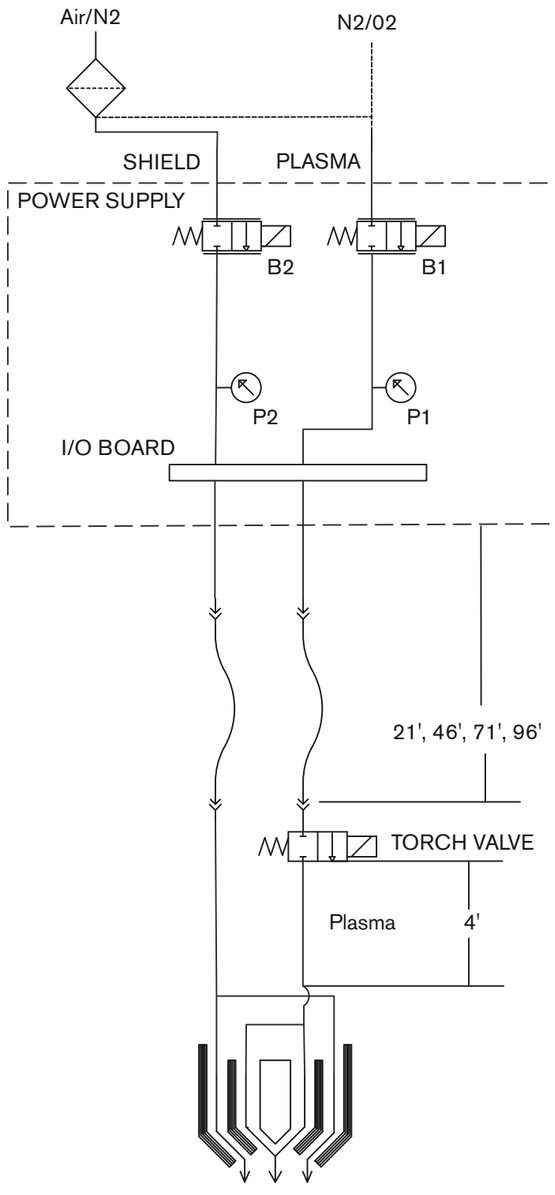
SHEET 6 OF 9 (A)



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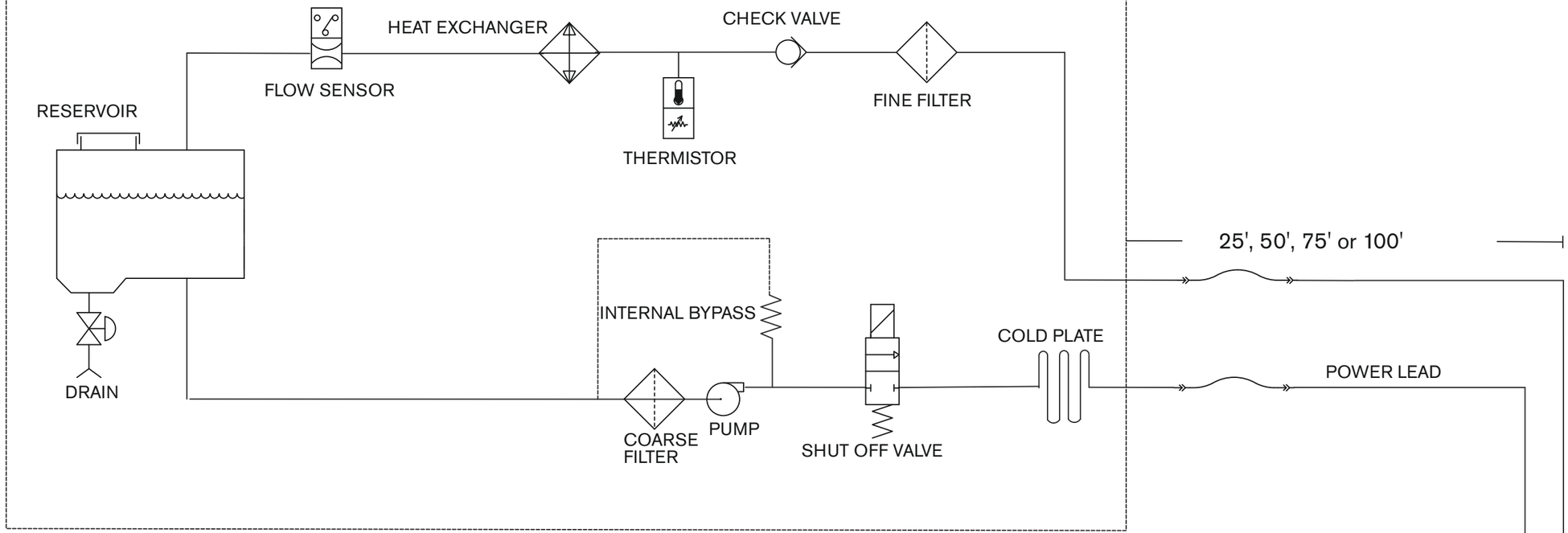
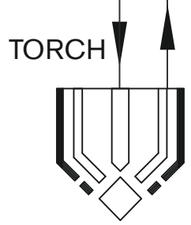
SHEET 7 OF 9 A

Power supply





ELEC SCH:MAXPRO200 POWER SUPPLY

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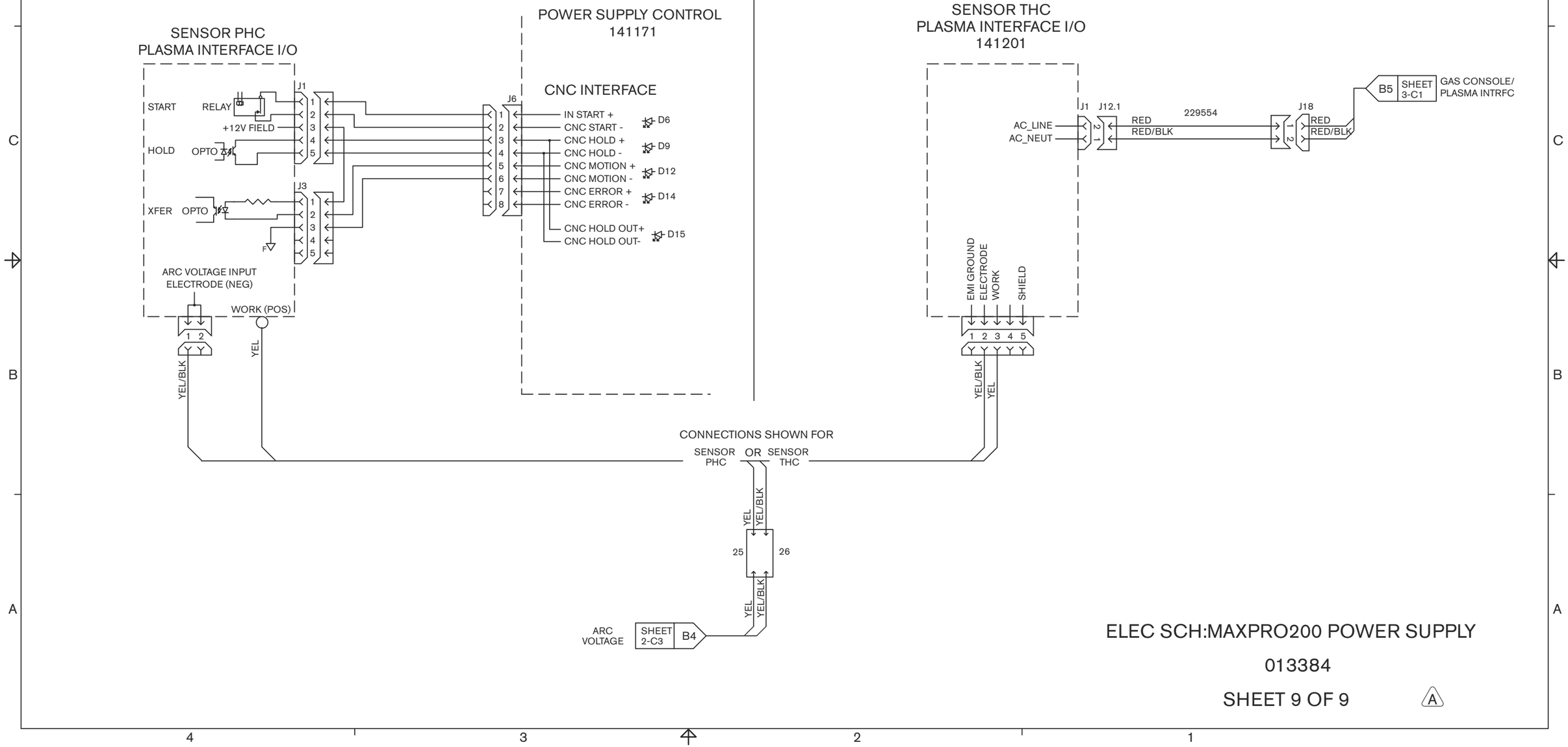
SHEET 8 OF 9 A



ELEC SCH:MAXPRO200 POWER SUPPLY

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SHEET 9 OF 9 (A)

Material Safety Data Sheet (MSDS) — Torch Coolant 30% PG Mixture

1 - Identification of the substance/mixture and of the company undertaking

Product identifier	Torch coolant 30% PG mixture
GHS product identifier	Not applicable.
Chemical name	Not applicable.
Trade name	Torch coolant 30% PG mixture
CAS No.	Not applicable.
EINECS No.	Not applicable.
REACH registration no.	Not available.
Relevant identified uses of the substance or mixture and uses advised against	
Identified use(s)	Industrial use only.
Uses advised against	Not available.
Details of the supplier of the safety data sheet	
Company Identification	Hypertherm
Telephone	+1 (603) 643-5638 (USA), +31 (0) 165 596 907 (Europe)
E-Mail (competent person)	technical.service@Hypertherm.com
Address	P.O. Box 5010, Hanover, NH 03755 USA (USA), Vaartveld 9, 4704 SE Roosendaal, Nederlands (Europe)
Emergency telephone number	**(800) 255-3924 (USA), +1 (813) 248-0585 (International)**

2 - Hazards identification

C Classification	None
GHS Classification Signal word(s)	None

According to regulation (EC) No. 1272/2008 (CLP)	None
According to Directive 67/548/EEC & Directive 1999/45/EC	None
Preparation is not classified as hazardous in the sense of directive 1999/45/EC and 2006/121/EC.	
Risk phrases	None
Safety phrases	None
Hazard statement(s)	None
Precautionary statement(s)	None

3 - Composition/information on ingredients

HAZARDOUS INGREDIENT 1	**% W/W**	**CAS No.**	**EC No.**	**EC Classification**
Propylene Glycol	30-50	57-55-6	200-338-0	None
GHS Classification				
	Not classified			None
HAZARDOUS INGREDIENT 2	**% W/W**	**CAS No.**	**EC No.**	**EC Classification**
Benzotriazole	<1.0	95-14-7	202-394-1	Xn, F
GHS Classification				
WARNING	Acute Tox. 4 (Oral, Dermal, Inhalation) Eye Irrit. 2, Aquatic Chronic 3			H302, 312, 319, 332, 412

For full text of R phrases see section 16. For full text of H/P phrases see section 16. Non-hazardous components are not listed.

4 - First aid measures

Inhalation	Unlikely to be hazardous by inhalation unless present as an aerosol.
Remove patient from exposure.	
Skin contact	Wash skin with water.
Eye contact	If substance has gotten into the eyes, immediately wash out with plenty of water for several minutes.
Ingestion	Laxative. Do not induce vomiting. If swallowed, seek medical advice immediately and show this container or label.
Further medical treatment	Unlikely to be required but if necessary treat symptomatically.

5 - Fire-fighting measures

Combustible but not readily ignited.

Extinguishing media	Extinguish preferably with dry chemical, foam or water spray.
Unsuitable extinguishing media	None known.

Fire fighting protective equipment	A self contained breathing apparatus and suitable protective clothing should be worn in fire conditions.

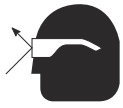
6 - Accidental release measures

Personal precautions	Put on protective clothing.
Environmental exposure controls	Absorb spillages onto sand, earth or any suitable adsorbent material.
Other	None

7 - Handling and storage

Handling	Unlikely to cause harmful effects under normal conditions of handling and use.
Storage	Keep container tightly closed and dry. Keep away from heat. Keep out of the reach of children. Keep away from oxidizing agents.
Storage temperature	Ambient
Storage life	Stable at ambient temperatures.
Specific use	Industrial use only.

8 - Exposure controls/personal protection



Respirators	Normally no personal respiratory protection is necessary. Wear suitable respiratory protective equipment if exposure to levels above the occupational exposure limit is likely. A suitable dust mask or dust respirator with filter type A/P may be appropriate.
Eye Protection	Safety spectacles.
Gloves	Wearing of chemical protective gloves is not necessary.
Body protection	None
Engineering Controls	Ensure adequate ventilation to remove vapors, fumes, dust etc.
Other	None

Occupational Exposure Limits

Substance	CAS No.	LTEL (8 hr TWA ppm)	LTEL 8 hr TWA mg/m3)	STEL (ppm)	STEL (mg/m3)	Note
Propylene Glycol	57-55-6	ne	10*	ne	ne	AIHA WEEL in the USA
Benzotriazole	95-14-7	ne	ne	ne	ne	None

9 - Physical and chemical properties

Information on basic physical and chemical properties

Appearance:	Liquid	Vapor pressure (mm Hg):	Not available
Color:	Pinkish - Reddish	Vapor density (Air=1):	Not available
Odor:	Slight	Density (g/ml):	1.0 ± 0.1 g/ml
Odor threshold (ppm):	Not available	Solubility (water):	Soluble
pH (Value):	5.5-7.0 (Concentrated)	Solubility (other):	Not established
Melting point (°C) / freezing point (°C):	< -0°C / (< 32°F)	Partition coefficient (n-octanol/ water):	Not available
Boiling point/boiling range (°C):	>100°C (>212°F)	Auto ignition temperature (°C):	Not available
Flash point (°C):	>95°C (>203°F)	Decomposition temperature (°C):	Not available
Evaporation rate:	Not available	Viscosity (mPa.s):	Not available
Flammability (solid, gas):	Non-flammable	Explosive properties:	Not explosive
Explosive limit ranges:	Not available	Oxidizing properties:	Not oxidizing
Other information:	None		

10 - Stability and reactivity

Reactivity	None
Chemical stability	Stable under normal conditions
Possibility of hazardous reactions	None
Conditions to avoid	None anticipated
Incompatible materials	Keep away from oxidizing agents
Hazardous decomposition product(s)	Carbon monoxide, Carbon dioxide, Nitrogen oxides

11 - Toxicological information

11.1.1 - Substances

Acute toxicity	
Ingestion	Low oral toxicity, but ingestion may cause irritation of the gastrointestinal tract.
Inhalation	Unlikely to be hazardous by inhalation.
Skin Contact	Mild irritant to rabbit skin.
Eye Contact	Mild irritant to the eye.
Hazard label(s)	None
Serious eye damage/irritation	Mild irritant to the eye.
Respiratory or skin sensitization	Mild irritant to rabbit skin.
Mutagenicity	Not known
Carcinogenicity	IARC, NTP, OSHA, ACGIH do not list this product or any components thereof as known or suspected carcinogen.
Reproductive toxicity	Not known
STOT-single exposure	Not known
STOT-repeated exposure	Not known
Aspiration hazard	Not known

12 - Ecological information

Toxicity	Do not let this chemical/product enter the environment.
Persistence and degradability	Biodegradable
Bioaccumulative potential	None anticipated
Mobility in soil	The product is predicted to have moderate mobility in soil.
Results of PBT and vPvB assessment	None assigned
Other adverse effects	None anticipated

13 - Disposal considerations

Waste treatment methods	Disposal should be in accordance with local, state or national legislation. No special measures are required. No specific waste water pretreatment required.
Additional Information	None

14 - Transport information

Not classified as dangerous for transport.

Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code.

15 - Ecological information

USA	
TSCA (Toxic Substance Control Act)	Listed
SARA 302 - Extremely Hazardous Substances	Not applicable
SARA 313 - Toxic Chemicals	Not applicable
SARA 311/312 - Hazard Categories	None
CERCLA (Comprehensive Environmental Response Compensation and Liability Act)	Not applicable
CWA (Clean Water Act) - CWA 307 - Priority Pollutants	None
CAA (Clean Air Act 1990) CAA 112 - Hazardous Air Pollutants (HAP)	None
Proposition 65 (California)	Not applicable.
State Right to Know Lists	CAS No. 95-14-7 Listed in MA, NJ, PA
Canada	
WHMIS Classification (Canada)	Not classified
Canada ingredient disclosure list	Not applicable
Canada (DSL/NDSL)	Listed.
EU	
EINECS (Europe)	Listed.
Wassergefährdungsklasse (Germany)	None

16 - Other information

The following sections contain revisions or new statements: 1-16.

Legend

LTEL	Long Term Exposure Limit
STEL	Short Term Exposure Limit
STOT	Specific Target Organ Toxicity
DNEL	Derived No Effect Level
PNEL	Predicted No Effect Concentration

References:

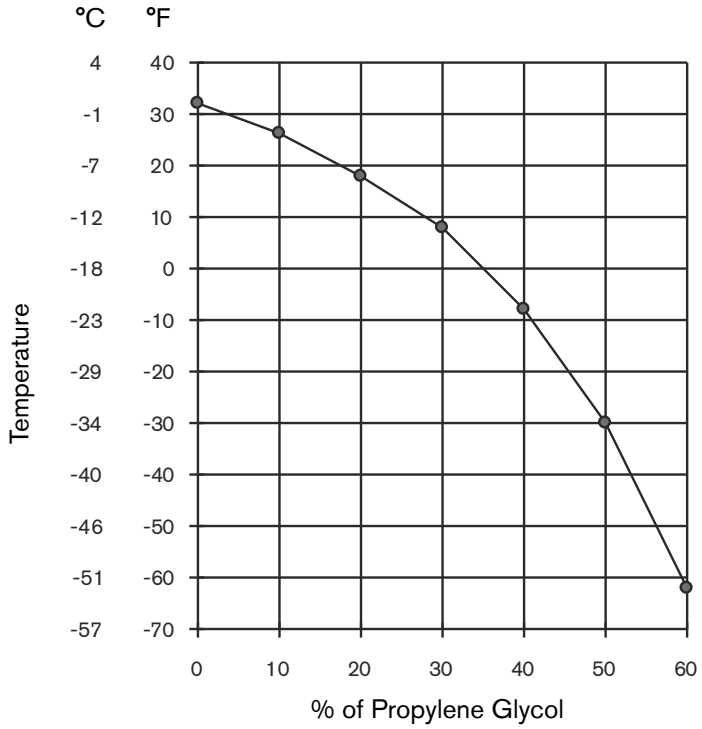
Risk phrases and safety phrases	None. Preparation is not classified as hazardous in the sense of directive 1999/45/EC and 2006/121/EC.
Hazard statement(s) and precautionary statement(s).	None. Preparation is not classified as hazardous in the sense of directive 1999/45/EC and 2006/121/EC.
Training advice	None

Additional information	USA - NFPA (National Fire Protection Association) - NFPA Rating: Flammability - 1 Health - 0 Instability/Reactivity - 0.

Information contained in this publication or as otherwise supplied to Users is believed to be accurate and is given in good faith, but it is for the Users to satisfy themselves of the suitability of the product for their own particular purpose. Hypertherm gives no warranty as to the fitness of the product for any particular purpose and any implied warranty or condition (statutory or otherwise) is excluded except to the extent that exclusion is prevented by law. Hypertherm accepts no liability for loss or damage (other than that arising from death or personal injury caused by defective product, if proved), resulting from reliance on this information. Freedom under Patents, Copyright and Designs cannot be assumed.

Note: The original safety data sheet was authored in English.

Freezing Point of Propylene Glycol Solution



MAXPRO200 Revision Changes	
Changed page	**Description of changes for revision 1 (date of revision March 2013)**
Cover and Title Page	Revision number and dates changed.
27 through 32	Font size changed for the Product Stewardship and Environmental Stewardship information to match font size used for EMC and Warranty. This added two pages to the Product Stewardship section.
121 through 125	Headers updated to match the “Power supply status” table on page 118.
130	Updated the description for error code 51 from “The pilot arc temperature has exceeded it’s maximum rating” to “Maximum pilot arc duration exceeded”. Changed corrective action 1 from “let the system cool off” to “Allow the power supply to idle with the fans running for 10 seconds.”
131	Updated the description for error code 67 to say “Main” transformer has over heated. Changed corrective action 2 and 4 to say “main transformer” instead of inductors. Changed corrective action 3 for error code 69 to say “inductor B’s” instead of the transformer’s.
132	Changed corrective action 1 for error code 93 to say “level” instead of height. Added corrective action 3 “The pump motor may have reached its internal thermal trip point. Make sure the side panel is installed, for proper airflow, and that the heat exchanger fan is working properly.”
133	Added “If the wiring is good, the IGBT may have failed.” to corrective action 4 for error codes 134 and 138.
139	Corrected 20 liters to 4 liters in step 2.
141	Updated the graph to accurately reflect the new flow sensor.
150	Corrected overlapping text (TP95 and DCKB) on the Chopper PCB graphic.
160	Corrected the Preventive maintenance protocol checklist to remove HPR references and make it MAXPRO specific.
161 through 163	Added Annual preventive maintenance kit part numbers, parts lists for the kits and the parts replacement schedule.
167	Changed item 4 description from Replacement filter element to “Air” filter element. Changed item 6 description from Replacement filter element to “Coolant” filter element.
169	Updated the graphic to show the new flow sensor and removed item 5 “Adapter: 1/2” push-in x 1/2 inch push-in tube” because it is no longer necessary.
172	Added “(includes PCB) to the description for item 2.
179	Added a recommended spare parts lists